21. CRETACEOUS NANNOFOSSILS FROM THE NORTHWEST AFRICAN MARGIN, DEEP SEA DRILLING PROJECT LEG 79[1]

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ABSTRACT

Deep Sea Drilling Project Leg 79 recovered Cretaceous nannofossils at two localities, Sites 545 and 547. Species diversity of the Cretaceous coccoliths is high, and the assemblages range in age from early Valanginian–early Hauterivian to latest Maestrichtian.

Site 545 and portions of Site 547 can be combined to form a composite section ranging from the upper Aptian–lower Albian to the middle to upper Cenomanian. As defined by nannofossil events, this section represents a complete record of sedimentary deposition. The interval appears to be the most extensive and complete Cretaceous section yet drilled off the Northwest African margin.

The Campanian and Maestrichtian sediments found at Site 547 (Hole 547A) are the youngest Cretaceous strata found on the Northwest African margin. Like the middle Cretaceous sections, the uppermost Maestrichtian of this interval also represents a complete record of sedimentation.

INTRODUCTION

During Deep Sea Drilling Project Leg 79, Sites 544, 545, 546, and 547 were drilled west of Morocco (Fig. 1). *In situ* Cretaceous sediments were recovered only from Sites 545 and 547 (Holes 547A and 547B). A primary goal of the cruise was to record the subsidence history of the carbonate platform seaward of the 3-km-high Mazagan Escarpment. It was hoped that calcareous nannofossils, foraminifers, and other fossil groups could be used to determine the age of sediments overlying the carbonate sequence and place age limits upon the drowning of the platform.

Situated on a slope at the base of the Mazagan Escarpment, Site 545 was positioned not only to investigate the subsidence of the platform but also to drill a Cretaceous sequence that recorded the erosional history of the steep escarpment.

Site 547 was located on the flank of a fault-controlled block, where it was believed that a thick Cretaceous sequence would be present. The sequence was drilled to recover a Cretaceous interval for biostratigraphic determinations and possibly to bracket more precisely unconformities dated in the Moroccan Basin on Leg 50. The recovery of Cretaceous sediments younger than Cenomanian was considered possible because of the thickness of the sequence. (No such sediments had previously been found on the Northwest African margin seaward of the continental shelf.)

Sediments from Sites 545 and 547 yielded Cretaceous nannofossils ranging in age from early Valanginian–early Hauterivian to late Maestrichtian. Table 1 lists the nannofossil taxa studied in this chapter. The majority of the bibliographic references for these taxa are given in Loeblich and Tappan (1966, 1968, 1969, 1970a, 1970b, 1971, 1973) and in Heck (1979a, 1979b, 1980a, 1980b, 1981a, 1981b, 1982a, 1982b, 1983). References not found therein are listed in the references of this paper.

METHODS AND PROCEDURES

For this calcareous nannofossil study, standard smear slides of all samples were examined on the light microscope. The smear slides were prepared as uniformly as possible, to allow more accurate abundance estimates. If flocculation of sediments occurred, a small amount of 3–5% Calgon [$(NaPO_3)_6$] solution was added to the slide to aid in dispersion.

Each smear slide was studied on the light microscope by making approximately 10 traverses across the slide at 1562× magnification. For each of the samples analyzed two abundances are given: the abundance of calcareous nannofossils on the slide and the abundance of individual species, as follows

Nannofossil specimens per field of view	Individual species abundance per field of view
A = abundant; 70+	D = very abundant; 10 or more specimens
V = very common; 50–69	A = abundant; 6 to 9 specimens
C = common; 30–49	V = very common; 3 to 5 specimens
F = few; 10–29	C = common; 1 to 2 specimens
R = rare; 1–9	M = moderately common; 1 specimen every 2–40 fields
E = essentially barren; 1 specimen every 2 or more fields,	F = few; 1 specimen every 41–60 fields
B = barren; no nannofossils observed	R = rare; 1 specimen every 61–120 fields
	P = present; 1 specimen every 121 or more fields

In Tables 2 and 3 abundances of reworked nannofossils are listed in lower-case letters; *in situ* taxa are in capital letters.

Preservation of the calcareous nannofossils in each sample was recorded as follows:

G = Good; specimens show little or no dissolution and/or overgrowth;

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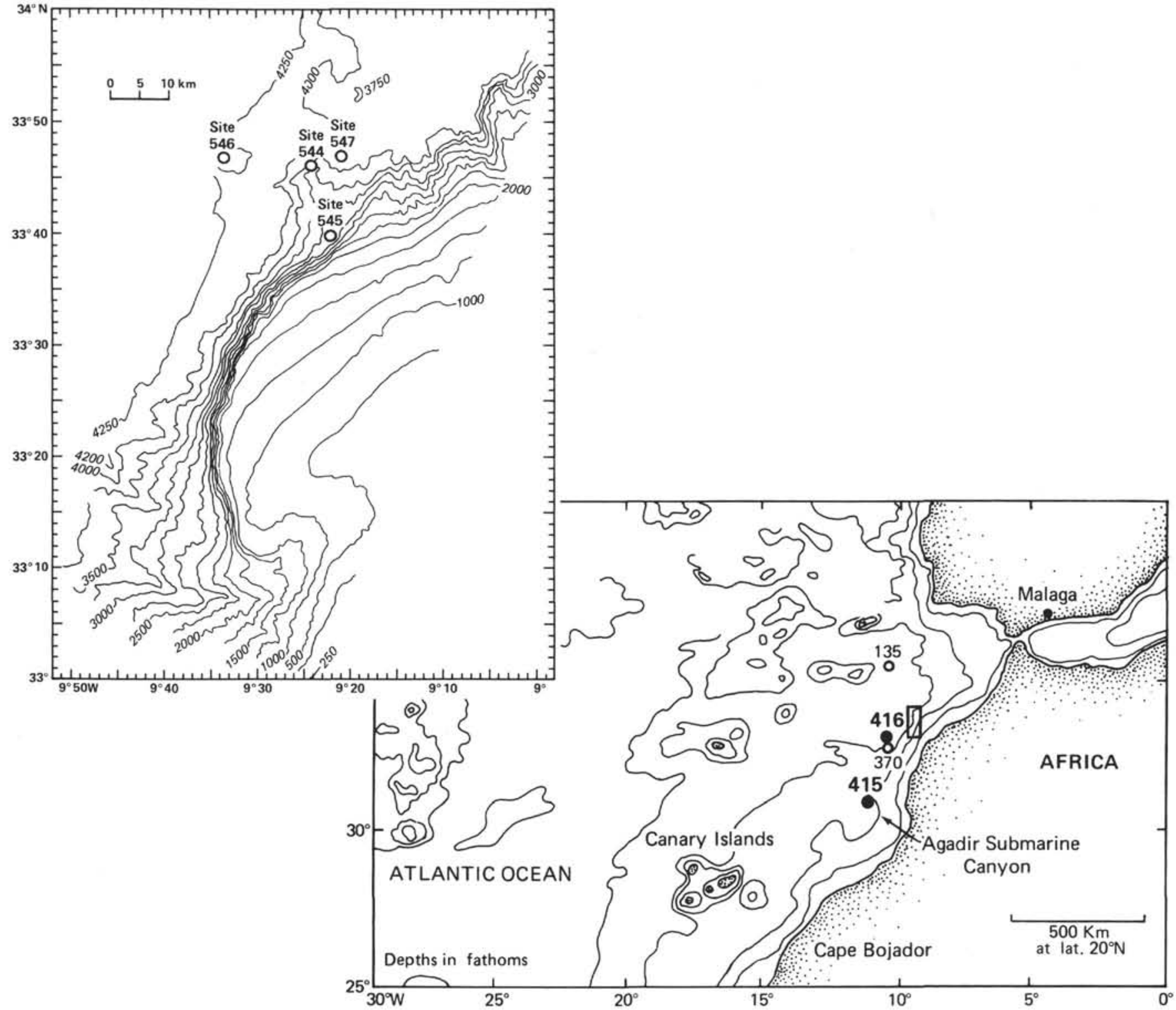

Figure 1. Location of sites drilled on Leg 79 and other DSDP legs recovering Cretaceous sediments off the Northwest African margin.

M = Moderate; specimens show some dissolution and/or overgrowth, but identification of taxa is possible;

P = Poor; specimens show extreme dissolution and/or overgrowth; identification of taxa usually possible but sometimes impaired.

CALCAREOUS NANNOFOSSIL BIOSTRATIGRAPHY AND ZONATION

The Cretaceous nannofossils of Leg 79 could not be zoned according to a single published zonation: some zones were difficult to determine and biostratigraphic resolution was lacking within others. Thus, a combination of three published zonations is used here: Thierstein (1973), from the earliest Berriasian to the late Albian; Manivit et al., (1977), from the late Albian to the late Turonian; and Verbeek (1977), from the late Turonian to the end of the Maestrichtian. The combined zonal scheme is illustrated in Figure 2. Even with this combination of zonations, other datum levels, including some of Perch-Nielsen (1979), were incorporated within zones to increase resolution or to improve zonal utility. This chapter uses a different zonal approach than that used in the site chapters for Leg 79.

The *Nannoconus colomii* Zone and the *Cretarhabdus crenulatus* Zone of Thierstein (1973) are not recognized in the samples studied. These zones range in age from the earliest Berriasian to the early Valanginian.

Calcicalathina oblongata Zone

Author. Thierstein (1971), modified by Thierstein (1973).

Definition. Interval from the first occurrence of *C. oblongata* to the first occurrence of *Lithraphidites bollii.*

Age. Early Valanginian–early Hauterivian.

Remarks. This zone is recognized in only two samples, 547B-6-1, 139–140 cm and 547B-6-2, 6–7 cm. The first sample contains *Diadorhombus rectus* which, according to Thierstein (1976), ranges within the mid-Valanginian. Wind and Čepek (1979) questioned this limited

Table 1. Nannofossil species considered in this study, listed alphabetically by specific name.

Corollithion achylosum (Stover) Thierstein, 1971
Ceratolithoides aculeus (Stradner) Prins and Sissingh *in* Sissingh, 1977
Lithraphidites acutum ssp. *eccentricum* Watkins (in press)
Braarudosphaera africana Stradner, 1961
Lithraphidites alatus Thierstein, 1972
Axopodorhabdus albianus (Black) Wind and Wise, 1976
Hayesites albiensis Manivit, 1971
Crucicribrum anglicum Black, 1973
Vekshinella angusta (Stover) Verbeek, 1977
Rhagodiscus angustus (Stradner) Reinhardt, 1971
Reinhardtites anthophorus (Deflandre) Perch-Nielsen, 1968
Rhagodiscus asper (Stradner) Reinhardt, 1967
Markalius astroporus (Stradner) Hay and Mohler, 1967
Watznaueria barnesae (Black) Perch-Nielsen, 1968
Microrhabdulus belgicus Hay and Towe, 1963
Cylindralithus biarcus Bukry, 1969
Flabellites biforaminis Thierstein, 1973
Watznaueria biporta Bukry, 1969
Discorhabdus biradiatus (Worsley) Thierstein, 1973
Watznaueria britannica (Stradner) Reinhardt, 1964
Amphizygus brooksii Bukry, 1969
Lithraphidites carniolensis Deflandre, 1963
Cruciellipsis chiastia (Worsley) Thierstein, 1972
Speetonia colligata Black, 1971
Nannoconus colomii (deLapparent) Kamptner, 1938
Micula concava (Stradner) Bukry, 1969
Cretarhabdus conicus Bramlette and Martini, 1964
Grantarhabdus coronadventis (Reinhardt) Grün, 1975
Cretarhabdus crenulatus Bramlette and Martini, 1964
Prediscosphaera cretacea (Arkhangelsky) Gartner, 1968
Cruciellipsis cuvillieri (Manivit) Thierstein, 1971
Arkangelskiella cymbiformis Vekshina, 1959
Microrhabdulus decoratus Deflandre, 1959
Tetrapodorhabdus decorus (Deflandre) Wind and Wise, 1977
Micula decussata Vekshina, 1959
Axopodorhabdus dietzmanni (Reinhardt) Wind and Wise, 1977
Zygodiscus diplogrammus (Deflandre) Gartner, 1968
Cribrosphaerella ehrenbergii (Arkhangelsky) Deflandre, 1952
Biscutum ellipticum (Gorka) Grün and Allemann, 1975
Nannoconus elongatus Bronnimann, 1955
Parhabdolithus embergeri (Noël) Stradner, 1965
Zeugrhabdotus erectus (Deflandre) Stradner, 1965
Eiffellithus eximius (Stover) Perch-Nielsen, 1968
Eprolithus floralis (Stradner) Stover, 1966
Scapholithus fossilis Deflandre, 1954
Marthasterites furcatus (Deflandre) Deflandre, 1959
Tranolithus gabalus Stover, 1966
Chiastozygus garrisonii Bukry, 1969
Quadrum gartneri Prins and Perch-Nielsen *in* Manivit et al., 1977
Corollithion geometricum (Gorka) Manivit, 1971
Quadrum gothicum (Deflandre) Prins and Perch-Nielsen *in* Manivit et al., 1977
Lithastrinus grillii Stradner, 1962
Lithraphidites helicoideus (Deflandre) Deflandre, 1963
Braarudosphaera hockwoldensis Black, 1973
Sollasites horticus (Stradner, Adamiker, and Maresch) Black, 1968
Micrantholithus hoschulzi (Reinhardt) Thierstein, 1971
Bidiscus ignotus (Gorka) Lauer *in* Grün et al., 1972
Parhabdolithus infinitus (Worsley) Thierstein, 1974
Markalius inversus (Deflandre) Bramlette and Martini, 1964
Rucinolithus irregularis Thierstein, 1972
Ceratolithoides kamptneri (Bramlette and Martini) Verbeek, 1976b
Broinsonia lacunosa Forchheimer, 1972
Stephanolithion laffittei Noël, 1957
Diazmatolithus lehmani Noël, 1965
Chiastozygus litterarius (Gorka) Manivit, 1971
Cretarhabdus loriei Gartner, 1968
Kamptnerius magnificus Deflandre, 1959
Cyclagelosphaera margereli Noël, 1965
Vagalapilla matalosa (Stover) Thierstein, 1973
Conusphaera mexicana Trejo, 1969
Braarudosphaera minute Filewicz, Wind, and Wise *in* Wind and Wise, 1976
Micula mura (Martini) Bukry, 1963
Quadrum nitidum (Martini) Prins and Perch-Nielsen *in* Manivit et al., 1977
Gartnerago obliquum (Stradner) Noël, 1970
Calcicalathina oblongata (Worsley) Thierstein, 1971
Micrantholithus obtusus Stradner, 1963
Ahmuellerella octoradiata (Gorka) Reinhardt, 1970
Tranolithus orionatus Stover, 1966
Broinsonia parca (Stradner) Bukry, 1969

Table 1. (Continued).

Manivitella pemmatoidea (Deflandre ex Manivit) Thierstein, 1971
Lithraphidites praequadratus Roth, 1978
Micula prinsii Perch-Nielsen, 1979
Corollithion protosignum Worsley, 1971
Lithraphidites quadratus Bramlette and Martini, 1964
Nannoconus quadriangulus Deflandre and Deflandre-Rigaud, 1962
Nannoconus quadriangulus apertus Deflandre and Deflandre-Rigaud, 1962
Diadorhombus rectus Worsley, 1971
Ahmuellerella regularis (Gorka) Verbeek, 1977
Braarudosphaera regularis Black, 1973
Octocyclus reinhardtii (Bukry) Wind and Wise, 1977
Corollithion rhombicus (Stradner and Adamiker) Bukry, 1969
Retecapsa schizobrachiata (Gartner) Grün, 1975
Cylindralithus serratus Bramlette and Martini, 1964
Broinsonia signata (Noël) Noël, 1970
Corollithion signum Stradner, 1963
Arkhangelskiella specillata Vekshina, 1959
Zygodiscus spiralis Bramlette and Martini, 1964
Rhagodiscus splendens (Deflandre) Verbeek, 1977
Braarudosphaera stenorheta Hill, 1976
Vagalapilla stradneri (Rood et al.) Thierstein, 1973
Gartnerago striatum (Stradner) Forchheimer, 1972
Cretarhabdus surirellus (Deflandre and Fert) Reinhardt emend. Thierstein, 1971
Eiffellithus trabeculatus (Gorka) Reinhardt and Gorka, 1967
Quadrum trifidum (Stradner) Prins and Perch-Nielsen *in* Manivit et al., 1977
Nannoconus truitti Bronnimann, 1955
Eiffellithus turriseiffeli (Deflandre) Reinhardt, 1965
Biscutum sp.
Chiastozygus sp.
Corollithion sp.
Lithistrinus sp.
Lucianorhabdus sp.
Seribiscutum sp.
Stradnerlithus sp.
Tetralithus sp.
Zygodiscus sp. 1
Zygodiscus sp. 2
Zygodiscus sp. 3
Zygodiscus sp. 4 (small)
Genus et sp. indet. 1

range, suggesting that *D. rectus* may extend into the Hauterivian. With only one sample containing *D. rectus*, this study can add no new information on its range.

The following zones, from Thierstein (1973), are not recognized in the samples studied: *Lithraphidites bollii* Zone, *Micrantholithus hoschulzi* Zone, and *Chiastozygus litterarius* Zone. These range in age from the early Hauterivian to the early Aptian.

Rhagodiscus angustus Zone

Author. Manivit (1971), modified by Thierstein (1973).

Definition. Interval from the first occurrence of *R. angustus* and/or *Eprolithus floralis* to the first occurrence of *Prediscosphaera cretacea.*

Age. Late Aptian–early Albian.

Remarks. The first occurrence of *R. angustus*, in this study, is not coincident with the first appearance of *E. floralis* as reported by Manivit (1971) and Thierstein (1973), but is encountered in younger sediments (Table 2, later). Perch-Nielsen (1979) also reports that *R. angustus* was found in sediments younger than *E. floralis.* Thus, in this study, the lowest occurrence of *E. floralis* is used as the lower boundary of the zone.

R. angustus was found somewhat inconsistently throughout the intervals studied, especially in Holes 547A

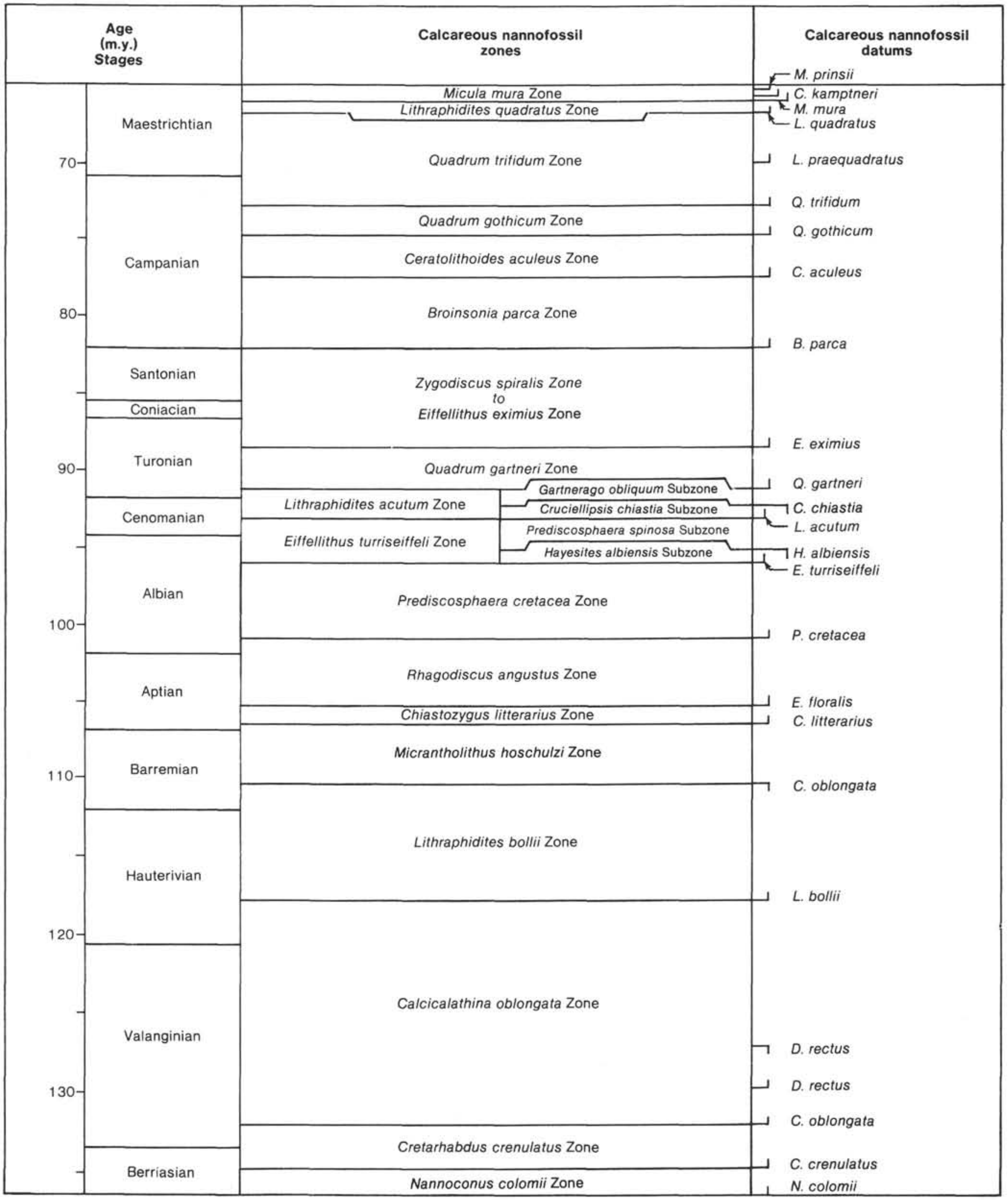

Figure 2. Cretaceous nannofossil zonal scheme used in this chapter. Sources: Thierstein (1973), Manivit et al., (1977), and Verbeek (1977).

and 547B. Preservation did not seem to be a factor: in many samples where *R. angustus* was absent preservation was good. Varying environmental conditions may be responsible for the sporadic occurrences of this coccolith.

The zone is recognized in Samples 545-56-6, 64–65 cm to 545-47-4, 47–48 cm; it is not present in Holes 547A or 547B.

Prediscosphaera cretacea Zone

Author. Thierstein (1971), modified by Thierstein (1973).

Definition. Interval from the first occurrence of *P. cretacea* to the first occurrence of *Eiffellithus turriseiffeli.*

Age. Early Albian–middle Albian.

Remarks. Manivit et al. (1977), unlike Thierstein (1973), distinguish *P. cretacea* from the smaller *P. columnata* and place the first occurrence of *P. columnata* at the level of the first appearance of *P. cretacea* according to Thierstein, 1973. Thus the *P. cretacea* Zone of Thierstein (1973) is equivalent to the *P. columnata* Zone of Manivit et al. (1977); both zones have the first occurrence of *Eiffellithus turriseiffeli* as the upper boundary datum. Following Thierstein, *P. columnata* is not separated from *P. cretacea* in this study.

This zone is recognized in the interval from Samples 545-47-3, 30–31 cm to 545-41-1, 42–43 cm. It is not present in Holes 547A or 547B.

Eiffellithus turriseiffeli Zone

Author. Thierstein (1971), modified by Manivit et al. (1977).

Definition. Interval from the first occurrence of *E. turriseiffeli* to the first occurrence of *Lithraphidites acutum.*

Age. Late Albian–middle Cenomanian.

Remarks. Manivit et al. (1977) recognize two subzones within this zone: *Hayesites albiensis* and *Prediscosphaera spinosa* subzones.

Hayesites albiensis Subzone

Authors. Manivit et al. (1977).

Definition. Interval from the first occurrence of *Eiffellithus turriseiffeli* to the last occurrence of *H. albiensis.*

Age. Late Albian.

Remarks. This subzone is present from Samples 545-40-6, 78 cm to 545-38-3, 92–93 cm, and 547B-6-1, 39–41 cm to 547A-63-1, 77–78 cm.

Prediscosphaera spinosa Subzone

Authors. Manivit et al. (1977).

Definition. Interval from the last occurrence of *Hayesites albiensis* to the first occurrence of *Lithraphidites acutum.*

Age. Latest Albian—middle Cenomanian.

Remarks. This subzone is recognized from Samples 545-38-1, 92–93 cm to 545-30-1, 27–28 cm, and Samples 547-62-2, 77–78 cm to 547A-46-3, 32–33 cm.

Lithraphidites acutum Zone

Author. Verbeek, *in* Manivit et al. (1977).

Definition. Interval from the first occurrence of *L. acutum* to the first occurrence of *Quadrum gartneri.*

Age. Middle Cenomanian–early Turonian.

Remarks. This zone is divided into two subzones by Manivit et al.: *Cruciellipsis chiastia* and *Gartnerago obliquum* subzones. Only the first of these is recognized here.

Cruciellipsis chiastia Subzone

Authors. Manivit et al. (1977).

Definition. Interval from the first occurrence of *Lithraphidites acutum* to the last occurrence of *C. chiastia.*

Age. Middle Cenomanian–late Cenomanian.

Remarks. This subzone is recognized from Samples 545-29-2, 68–69 cm to 545-28-1, 9–10 cm, and Samples 547A-46-2, 32–33 cm to 547A-39-1, 10–11 cm.

The *Quadrum gartneri* Zone from Manivit et al. (1977) is not present in the samples studied. This zone and the preceding *G. obliquum* subzone range from the late Cenomanian to the late Turonian in age.

The following zones, from Verbeek (1977), were not present in the study material: *Eiffellithus eximius* Zone; *Marthasterites furcatus* Zone; *Broinsonia lacunosa* Zone; *Micula concava* Zone; *Rucinolithus hayi* Zone; *Zygodiscus spiralis* Zone; and *Broinsonia parca* Zone. These zones range from late Turonian to early Campanian in age.

Ceratolithoides aculeus Zone

Author. Verbeek (1977).

Definition. Interval from the first occurrence of *C. aculeus* to the first occurrence of *Quadrum gothicum.*

Age. Early Campanian–middle Campanian.

Remarks. This zone is found from Samples 547A-38-3, 12–13 cm to 547A-38-1, 134–135 cm; it is not present at Site 545.

Quadrum gothicum Zone

Author. Martini (1976), *in* Verbeek (1977).

Definition. Interval from the first occurrence of *Q. gothicum* to the first occurrence of *Q. trifidum.*

Age. Middle Campanian.

Remarks. This zone is recognized only from Samples 547A-37-4, 65–66 cm to 547A-36-2, 82–83 cm.

Quadrum trifidum Zone

Author. Verbeek (1977).

Definition. Interval from the first occurrence of *Q. trifidum* to the first occurrence of *Lithraphidites quadratus.*

Age. Late Campanian–middle Maestrichtian.

Remarks. As defined by Verbeek (1977), the original upper limit of this zone was the early Maestrichtian, based on the first occurrence of *L. quadratus.* However, many authors, including Thierstein (1976), Sissingh (1977), Roth (1978), and Perch-Nielsen (1979), place the first appearance of *L. quadratus* in the middle Maestrichtian. In this study, the first occurrence of *L. quadratus* is elevated to the middle Maestrichtian level at which Sissingh (1977) and Perch-Nielsen (1979) place it, and a first occurrence datum for *L. praequadratus* is then erected at the level of Verbeek's *L. quadratus* datum (early Maestrichtian). This leaves the *Quadrum trifidum* Zone with its original boundary datums but raises the upper boundary to the middle rather than lower Maestrichtian, thus extending the range of the zone. The *L. quadratus* Zone thus also retains its original boundary datums but is given a shorter range.

Samples 547A-36-1, 26–27 cm to 547A-35-1, 67–68 cm are assigned to the interval from the base of this zone to the *L. praequadratus* datum. No nannofossils were found in this zone above the *L. praequadratus* datum.

Lithraphidites quadratus Zone

Authors. Bukry and Bramlette (1970), *in* Verbeek (1977).

Definition. Interval from the first occurrence of *L. quadratus* to the first occurrence of *Micula mura.*

Age. Middle Maestrichtian.

Remarks. This zone is present only in Samples 547A-34-7, 14–15 cm to 547A-33-5, 49–50 cm.

Micula mura Zone

Authors. Bukry and Bramlette (1970), *in* Verbeek (1977).

Definition. Interval from the first occurrence of *M. mura* to the extinction of most Cretaceous calcareous nannofossils.

Age. Late Maestrichtian.

Remarks. To further divide the latest Maestrichtian, two datum levels of Perch-Nielsen (1979) are used within this zone. The datum levels are defined by the first occurrences of *Ceratolithoides kamptneri* and *Micula prinsii.*

Samples 547A-33-4, 119–120 cm to 547A-33-1, 86–87 cm are within the interval bounded by the base of the zone and the *C. kamptneri* first occurrence datum. The interval between the first occurrence of *C. kamptneri* and the first occurrence of *M. prinsii* is recognized in Samples 547A-33-1, 86–87 cm to 547A-33-1, 16 cm. Samples 547A-32,CC (16 cm) to 547A-32-4, 67 cm fall within the interval bounded by the first occurrence of *M. prinsii* and the extinction of most Cretaceous nannofossils. This zone is not recognized at Site 545.

Site 545 (33°39.86′N; 09°21.88′W; water depth 3142 m)

Site 545 was drilled northwest of the Mazagan Plateau, at the base of the Mazagan Escarpment. The Cretaceous sediments recovered are 276 m thick and consist predominantly of a greenish gray nannofossil claystone. Nannofossil diversity at this site is generally high. A range chart showing species abundance and distribution is given in Table 2.

The middle to upper Cenomanian (*Lithraphidites acutum* Zone, *Cruciellipsis chiastia* Subzone) is present from Samples 545-28-1, 9–10 cm to 545-29-2, 68–69 cm (255–274 m). The nannofossil abundances range from common to very common and preservation is good.

Mid-Cenomanian to upper Albian sediments (*Eiffellithus turriseiffeli* Zone) are present from Samples 545-30-1, 27–28 cm to 545-40-6, 7–8 cm (274–379 m). The coccolith assemblages are very common to abundant and are well preserved.

The upper Albian to upper Aptian (*Prediscosphaera cretacea* Zone and *Rhagodiscus angustus* Zone) is recognized in Samples 545-41-1, 42–43 cm to 545-56-6, 64–65 cm (379–531 m). Preservation of the nannoflora is generally good with the abundances ranging from common to abundant. The lithology of Samples 545-56-1, 0 cm through 545-56-4, 40 cm is a muddy nannofossil ooze; this is different from the nannofossil claystone of the overlying Cretaceous sediments. Below this, in the lowest few meters of the core, a dolomitized clayey nannofossil chalk is found. Corresponding to this increase in dolomitization is a rapid decrease in the abundance and preservation of the nannofossil assemblages. Sample 545-56-6, 64–65 cm has a moderate preservation, rare specimens, and abundant dolomite rhombs. Core 57 is dolomitized limestone thought to be Middle–Late Jurassic in age.

Site 547 (33°46.84′N; 09°20.98′W; water depth 3939 m)

Site 547 was drilled on the northeastern flank of the same fault-controlled sialic block as Site 544. A total of 404 m of Cretaceous sediments were drilled at Site 547, which includes Hole 547A and Hole 547B (a reentry hole). The calcareous nannofloral diversity is typically high at this site. A range chart showing species abundance and distribution is given in Table 3.

The Maestrichtian and Campanian sediments, are composed primarily of greenish gray nannofossil chalk. The upper Maestrichtian (*Micula mura* Zone) is recognized in Samples 547A-32-4, 67 cm to 547A-33-4, 119–120 cm (~370–~379.5 m). This zone is further subdivided by the *C. kamptneri* and *M. prinsii* first occurrence datums, showing the continuity of the latest Maestrichtian at this site. The nannofossil assemblage has moderate to good preservation, and abundances vary from few to abundant.

Middle Maestrichtian sediments (*Lithraphidites quadratus* Zone) are found in Samples 547A-33-5, 49–50 cm to 547A-34-7, 14-15 cm (~379.5-393 m). Preservation is moderate to good and the abundance is generally common to very common. Reworking of older nannofossils is evident within some samples of this zone. The reworked taxa include *Broinsonia parca, Quadrum gothicum, Q. trifidum, Q. nitidum, Eiffellithus eximius; Marthasterites furcatus;* and *Lithastrinus grilli.* The nannofossils *B. parca, Q. gothicum, Q. trifidum, L. grilli,* and *E. eximius* are found *in situ* beneath an unconformity between Cores 34 and 35 (Table 3). *M. furcatus* and *Q. nitidum* are not found in any sediments beneath the reworked interval, including those just above the extensive hiatus (between Cores 38 and 39) which marks the absence of the upper Cenomanian to lower Campanian. It could be expected that a taxon ranging only during the time of a hiatus might be found immediately above that hiatus, but it is not likely that it would be found above a younger hiatus, as is the case here with *M. furcatus.* Neither *M. furcatus* nor *Q. nitidum* are found in sediments beneath the reworked interval, and it would appear that they were transported from outside the study area, possibly upslope from the site location. The other five reworked taxa may have come from the sediments beneath the hiatus or from outside the study area. Regardless of where these reworked taxa originated, it is clear that at least two horizons of coccoliths were eroded to provide the reworked nannofossil assemblage, because the stratigraphic range of *M. furcatus* (Coniacian to lower Campanian) does not overlap those of *Q. gothicum* (mid-Campanian to lower Maestrichtian) or *Q. trifidum* (upper Campanian to lower Maestrichtian). Toward the hiatus between Cores 34 and 35, reworked nannofossils become more common. This unconformity separates the *Lithraphidites quadratus* Zone (mid-Maestrichtian) from the older *Q. trifidum* Zone (late Campanian-early Maestrichtian). Samples 547A-35-1, 67-68 cm to 547A-36-1, 26-27 cm (393-~398 m) belong to the *Q. trifidum* Zone. Preservation is moderate to good, with abundances tabulated as very common.

The middle to lower Campanian (*Q. gothicum* and *Ceratolithoides aculeus* zones) is present in Samples 547A-36-2, 82-83 cm to 547A-38-3, 12-13 cm (~398-421.5 m). The coccoliths in this interval differ from the overlying Upper Cretaceous assemblages; preservation is generally poor to moderate and nannofossils are few to very common in abundance.

Coinciding with the hiatus between Cores 38 (*C. aculeus* Zone) and 39 (*L. acutum* Zone) is a lithology change from the overlying nannofossil chalk to nannofossil-bearing claystone beneath. Because of bioturbation, evidenced by burrows, younger coccoliths from the interval above the hiatus have been transported downward into Sample 547A-39-1, 10-11 cm. The transported nannofossil assemblage is reduced in both abundance and diversity from the *in situ* assemblage above.

Samples 547A-39-1, 10-11 cm to 547A-46-2, 32-33 cm (421.5-~490 m) are assigned to the *L. acutum* Zone, *Cruciellipsis chiastia* Subzone of middle-late Cenomanian age. Preservation of the nannofossil assemblage is good, and specimens are very common to abundant. The main lithology of this interval is a grayish green nannofossil-bearing claystone, much like that of the Cenomanian to Aptian of Site 545.

The middle Cenomanian to the uppermost Albian (*Eiffellithus turriseiffeli* Zone) is represented in Samples 547A-46-3, 32-33 cm to 547B-6-1, 39-41 cm (~490-~772.5 cm). The mid-Cenomanian to uppermost Albian sediments (Cores 39 to 62) are generally composed of grayish green nannofossil-bearing claystone similar to that found above. The remainder of the upper Albian (Cores 547A-63 to 547B-6-1, 105 cm) consist predominantly of interbedded nannofossil mudstone and nannofossil-bearing claystone. It has been determined that little overlap occurs between Hole 547A and the reentry hole Hole 547B; Core 73 of Hole 547A correlates with Core 1 of Hole 547B (see Site 547 site chapter, this volume).

An apparent unconformity exists between Samples 547B-6-1, 39-41 cm (*E. turriseiffeli* Zone) and 547B-6-1, 139-140 cm (*Calcicalathina oblongata* Zone). The abundance of the nannofossil assemblage in Sample 547B-6-1, 139-140 cm (~773.4 m) is common, and preservation is moderate. Sample 547B-6-2, 6-7 cm (~773.6 m) has good preservation and very common specimens. Both samples are early Valanginian-early Hauterivian in age and correspond to the *Calcicalathina oblongata* Zone. Samples 547B-6-1, 139-140 cm, 547B-6-2, 6-7 cm, and 547B-6-3, 57-58 cm were taken from claystones interbedded with bioclastic wackestones and limestone conglomerates.

The age of Sample 547B-6-3, 57-58 cm (~775.6 m) is indeterminate because preservation was poor and specimens are few.

Hiatuses

As indicated above, a number of significant hiatuses are present in these sections. The Cenomanian of Site 545 lies unconformably beneath lower-middle Miocene sediments. Another unconformity exists between the upper Aptian-lower Albian dolomitized sediments and the Middle-Upper Jurassic dolomite (see Site 545 site chapter, this volume). No other hiatuses are evident within the Cretaceous of this site.

The uppermost Maestrichtian of Hole 547A lies beneath sediments of early Danian age. However, the sequence spanning the Cretaceous/Tertiary boundary is not continuous, since the *Biantholithus sparsus* Zone (Romein, 1977), earliest Danian, is apparently absent. A more detailed study of the Cretaceous/Tertiary boundary drilled during this cruise is planned.

A hiatus in Hole 547A, between Samples 547A-34-7, 14-15 cm (middle Maestrichtian) and 547A-35-1, 67-68 cm (late Campanian-early Maestrichtian) spans a time of between 4 and 7 m.y. approximately, according to the absolute time scale (Fig. 2) utilized by Thierstein (1976).

The major hiatus, noted between Samples 547A-38-3, 12-13 cm (early-middle Campanian) and 547A-39-1, 10-11 cm (middle-late Cenomanian) represents 14 to 19 m.y., approximately and excludes the lowermost Campanian, Santonian, Coniacian, Turonian, and uppermost Cenomanian from the sedimentary record.

A disconformity lies between Samples 547B-6-1, 39-41 cm (upper Albian) and 547B-6-1, 139-140 cm (lower Valanginian-lower Hauterivian). The short interval (1 m) between the two samples represents some 22 to 37 m.y., suggesting the existence of one or more hiatuses. The presence of limestone beds between the samples makes it difficult to pinpoint precisely the position of the disconformity using nannofossil biostratigraphy, because the interval could not be studied by smear slides. Lower in the section, Sample 547B-6-2, 6-7 cm, of early Valanginian-early Hauterivian age, and Sample 547B-6-4, 47-48 cm, of Late Jurassic age, are also separated by a limestone sequence; thus it is again difficult to establish the position of a probable hiatus. This is especially true since the age of Sample 547B-6-3, 57-58 cm is undetermined.

Table 2. Distribution of Cretaceous nannofossils at Site 545.

Core-Section (interval in cm)	Preservation	Abundance	Amphizygus brooksii	Axopodorhabdus albianus	A. dietzmanni	Bidiscus ignotus	Biscutum ellipticum	B. sp.	Braarudosphaera africana	B. minuta	B. regularis	B. stenorheta	Broinsonia signata	Chiastozygus garrisonii	C. litterarius	C. sp.	Corollithion achylosum	C. geometricum	C. protosignum	C. rhombicum	C. signum	C. sp.	Cretarhabdus crenulatus	C. conicus	C. loriei	C. surirellus	Cribrosphaerella ehrenbergii	Crucirabrum anglicum	Cruciellipsis chiastia	Cyclagelosphaera margereli	Discorhabdus biradiatus	Eiffellithus trabeculatus	E. turriseiffeli	Eprolithus floralis	Flabellites biforaminis	Gartnerago obliquum	Grantarhabdus coronadventis	Hayesites albiensis	Lithastrinus sp.	Lithraphidites acutum eccentricum	L. alatus	L. carniolensis
28-1, 9-10 cm	G	C	R	M	R	M	V						F	F	R	M	M	M		R	M			R		M	M		R	F		F	M	F	R		R		R	R		M
29-1, 20-21 cm	M	C	R	F	R	M	V							F	F	M	M	M		R	M	F			R	M	M		R			R	M	F	R		R		P	F		M
29-2, 68-69 cm	G	V		M	P	M	A							M	F	F	M	C		F	M	M		R		M	M		R	M		F	M	F	R	F	R			R		C
30-1, 27-28 cm	G	V	R	M	R	M	A						R	M	F	M	M	M		F	M	M		R	R	M	M		R	F		F	M	M	R	P	R					C
31-1, 27-28 cm	G	C	F	M	R	M	V	R						M	M	M	M	M			M	F		F		M	M		F	M		P	M	R	R	R	R					M
31-2, 27-28 cm	M	V		M	R	M	V							F	F	M	M	M		F	M	M		R	R	M	M		F	M		R	M	R	R		R		F			C
32-1, 37-38 cm	G	V	R	M	R	M	V	P						M	M	F	M	C		M	M	M		R	R	M	M	P	R	M		R	M	F	R	R	R				R	C
33-1, 60-61 cm	G	V	R	M	M	M	A	R						M	M	M	M	M		F	M	M		F	R	M	M	R	M	F		R	M	F	R	P	F		F		R	C
34-1, 30-31 cm	G	V	R	M	F	M	V	R					R	M	M	R	M	M		R	M	M		F	F	M	M	R	M	M		F	C	F	F	R	R	p	P		R	M
34-3, 30-31 cm	G	C	F	M	F	M	V	R						F	M	M	M	M		R	M	M		R		M	M	R	F	F		F	M	F		P	F				R	M
35-1, 20-21 cm	G	C	F	M	F	M	A	R						F	F	M	M	M			M	M		F		M	M		F	F		R	M	F			R				P	M
35-2, 20-21 cm	G	C	F	M	R	M	A	R					R	M	M	M	M	M		R	M	M		R	P	M	M	P	F	M		P	M	F	R	R	R				R	C
36-1, 74-76 cm	G	V		M	R	M	V	F				R		M	M	M	M	M			M	M		F	R	M	M		R	M		R	M	R			R					M
36-3, 101-103 cm	G	V	F	F	R	M	V	R	P	P		R		M	F	M	M	M		R	M	M		F	P	M	M		P	M			M	R	R		P					M
37-1, 52-53 cm	G	V	F	F	F	M	A	F	R	R				M	F	M	M	M			M	F		F	R	M	M		R	M			C	R	F		R					M
37-2, 52-53 cm	G	V	F	M	R	M	V	R	F	F		F	R	M	F	M	M	M		F	M			R	R	M	M	R	R	M		R	M	F	F	P	F				P	C
37-3, 52-53 cm	G	V	F	M	F	M	A	R	R				P	M	M	M	M	M		R	M	R		F		M	M	P	R	M			M	R	F	P	R				R	M
38-1, 92-93 cm	G	C	F	F	R	M	V						R	M	F	M	M	M			M	R		R	R	M	M		F	M		R	M	F	R	P	R				R	M
38-3, 92-93 cm	G	V	F	F	R	M	A	P	R	R				M	F	M	M	M		F	M	R		M		M	M		F	M			M	F	R		R	R			R	M
39-1, 98-99 cm	G	V	R	F	R	M	C		R	R				F	F	M	M			R	M	P		F	P	M	R		R	M			R	R	R		R	R				M
39-2, 98-99 cm	G	C	F	M	R	M	C		R	F		R		F	F	M	F	M		F	M	R		F	R	M	R	P	R	F				R	F	P	R	F				M
39-4, 98-99 cm	G	A	M	M	F	M	V		F	F		R		M	F	M	M	M		R	M	R		R	F	M	F		R	M				M	F		R	R				M
40-1, 7-8 cm	G	A	R	F	P	M	V		R					M	F	M	M	M		R	M	F		F		M	F		R	R		P	R	F	F		F	F				M
40-3, 7-8 cm	G	C	R	F	R	M	V			P				F	F	M	M	F			M			R	R	M	R		R	R				R	R		R	P				M
40-5, 7-8 cm	G	V	F	F	R	M	V		F	F				M	F	M	M	M	R	R	M	F		F		M	R		F	M				M	R		R	F				M
40-6, 7-8 cm	G	A	R	R	M	M	C								F	M	M	M	F	R	F			F	R	M	R	P	F	M			F	M	M		R	F				C
41-1, 42-43 cm	G	C			M	M	C						P		R	F	M	M	P					F	F	M	M		F	M				M	M		R	R				M
41-2, 58-59 cm	G	C	R		R	M	C	P							F	F		F						R		F	R		M	M				M	M		R	R				M
41-4, 30-31 cm	G	V			R	M	C								F	F	M	F	F					R		F			F	M				M	M		R	R				M
42-1, 30-31 cm	G	V			R	M	C								F	F	M	M	R					R		F			M	M				M	F							M
42-2, 40-42 cm	G	C			R	M	C						P		F	F	F		R				R	R		F			M	F				M	F		P	R				M
42-3, 20-22 cm	G	V			F	M	M								F	F	M	M	F				R	F		F			M	M				M	F		R	R				M
42-5, 20-22 cm	G	V			F	M	C	P							F	M	M	M	M					F		M			F	F				M	F		R	P				C
43-1, 69-71 cm	G	C			M	M	C								F	F	M	M	F		P		P	R		M			M	M				M	M		R	F				C
43-3, 69-71 cm	G	V			F	M	C								F	F	M	M	F					F		M			M	M				M	M		R	F				M
43-5, 148-150 cm	G	V			F	M	C	P							F	F	M	F	R				P	F	R	M			M	F				M	F		R	R				M
43-7, 30-32 cm	G	V			F	M	C								F	F	M	F	R					F		F			M	F				M	M		R	R				M
44-1, 22-24 cm	G	V			F	M	C	M							M	F	F	R						F	P	F			M	F				M	M							M
44-2, 10-13 cm	G	V			R	M	C	R							F		R	R	R					F		M			M					M	F		R					M
45-1, 77-79 cm	G	V			F	M	C								M	R	F		M					F		F			M	R				M	F		F	R				C
45-2, 49-52 cm	G	C			F	M	C								F	R	M	F	M					F	R	F			M					F	F		R					M
45-4, 70-72 cm	G	V			M	M	C	F							M	R	F	F	R					F	R	F			M	F				M	F		R	R				C
46-1, 20-21 cm	G	V			M	M	C								M	F	F	F	M					F	R	M			M	M					M		M					C
46-3, 39-40 cm	G	C			F	M	V	F							F	F	F	R	M					F	R	M			M	R					F		R					C
46-5, 9-10 cm	G	V			M	M	C	R							M	M	F	M	M					M		M			M	F					M		F					C
47-1, 93-94 cm	G	V			F	M	C								M	F	R	M	R					M	R	F			M	F					M		R					M
47-3, 30-31 cm	G	V			F	M	C								M	F	R	F	M					M	R	F			M	F				F	M		M					M
47-4, 47-48 cm	G	V			R	M	M		P		P				M	F	R							F		F			M	F				M	M		R					M
47-5, 53-54 cm	G	F				M	M				P				R									R					M	F				R	F							M
47-6, 76-78 cm	G	V			M	M	C								R			F	M					F		F			M	M				M	F		R					M
48-1, 56-57 cm	G	V			R	M	M								F									F	R	F			M	P				M	R							M
48-3, 63-64 cm	G	V			F	M	C								F	R	R	F	R					R	R	F			M	F				M	M		R					M
48-5, 44-45 cm	G	V			M	C	C	R	R		P				F	F	F	M	F					F	F	F			M	M				F	M		F					C
48-7, 22-23 cm	G	C			R	M	C	R	P						F	R	R	R	P					R		F			M	M				F	F		R					M
49-1, 27-28 cm	G	C				M	M								F	R	R		R						F	F			M	M				M	F							M
49-2, 21-22 cm	G	C			R	M	M				P				F	R								R		M			M					R	F							M
49-4, 3-4 cm	G	C			F	M	M	R							F		R	R	R					R		M			M	F				R	F		P					M
49-6, 20-21 cm	G	C				M	C	P			R				M		P		P				R	F	R	M			M					R	M							M
50-1, 32-33 cm	G	C			R	M	M				P				R		R		R					R	R	M			M	F				F	F							M
50-3, 53-54 cm	G	A	P		M	C	C	R							F	R	F	R	R					R	R	M			M	R				F	F		R					M
50-5, 51-52 cm	G	A	R		M	C	C				F				F	F	M	F	F			R		F	R	M			M	R				R	M		R					M
51-1, 53-54 cm	G	V			M	M	C				F				M	F	M	M	M					F		M			M	F				F	F		F					C
51-3, 46-47 cm	G	C				C	C				R				F	F		R	R					F		M			M	F				M	M							M
51-5, 36-37 cm	G	C				M	M				R				R		P									M			M	R				R	R							M
52-2, 70-72 cm	G	C			R	M	M	P			F				F	R	R	R	R					P		M			M					F	F		P					M
52-4, 0-3 cm	G	V			F	M	C				R				R	R	R	F	F					R	P	M			M					F	M							C
52-6, 92-94 cm	G	A			R	C	C				R				M	F	R	M						F	R	M			M					M	M		R					M
53-1, 124-126 cm	G	A			M	M	V				R				M	M	M	M	M			F		M	R	M			M					M	M		R					C
53-3, 146-148 cm	G	V	R		F	M	C				R				M	R	F	F	F					F	R	M			M	M				M	M		R					C
53-5, 118-122 cm	G	V	R		M	M	C								M	M	F	F	M					M	R	M			M	R	P			M	M		R					C
54-1, 80-82 cm	G	V			M	C	C								F	M	R	M	M					F		M			M	M				F	F							C
54-3, 71-73 cm	G	V			F	C	M								M	F	F	R						F	R	M			M	F				M	M		R					M
54-5, 70-72 cm	G	V			F	M	C								M	R		F						R	R	M			M	M	R			M	M		R					M
54-7, 22-24 cm	G	A	R		F	M	C				R				M	F	R	R	R				P	M		M			M	M				M	M		R					M
55-1, 68-69 cm	G	V	F		M	C	C	P			R				M	F		M	M					F	P	M			M		R			M	M		R					M
55-3, 60-61 cm	G	C			F	C	M								M	F		F	F					F	P	M			M	M				M	M		R					M
55-5, 6-7 cm	G	A			M	C	C								M	M		F	F					R	P	M			M	M				M	M		P					M
56-2, 78-79 cm	G	V			F	C	M								M			M	M					F		M			M	M	R			M	M		P					
56-4, 63-64 cm	G	A			R	V	C								M	R			R					F	R	M			M	M	R			M	M							
56-5, 97 cm	G	V				C	M								M	R								F		M			M	M	R			F	M							
56-6, 64-65 cm	M	R				R	R																						R						R							
56-7, 9-11 cm		B																																								

Note: D = very abundant; A = abundant; V = very common; C = common; M = moderately common; F = few; R = rare; P = present; E = essentially barren; B = barren. Quantitative estimates for these symbols are given in the text. For preservation, G = good; M = moderate; P = poor, as defined in the text.

Table 2. (Continued).

Lucianorhabdus sp.	Manivitella pemmatoidea	Markalius inversus	Micrantholithus hoschulzi	M. obtusus	Microrhabdulus belgicus	Nannoconus colomii	N. elongatus	N. quadriangulus	N. quadriangulus apertus	N. truittii	Octocyclus reinhardtii	Parhabdolithus embergeri	P. infinitus	Prediscosphaera cretacea	Rhagodiscus asper/splendens	R. angustus	Rucinolithus irregularis	Scapholithus fossilis	Seribiscutum sp.	Sollasites horticus	Stephanolithion laffittei	Tetrapodorhabdus decorus	Tranolithus gabalus	T. orionatus	Vagalapilla matalosa	V. stradneri	Vekshinella angusta	Watznaueria barnesae	W. biporta	W. britannica	Zeugrhabdotus erectus	Zygodiscus diplogrammus	Z. sp. 1	Z. sp. 2	Z. sp. 3	Z. sp. 4 (small)	Gen. et spec. indet. 1	Zones	
	F											R		M	M	F		F	R	F	M	R	R	M	F	M	R	M			M	M		M	M	V	F	*Cruciellipsis chiasta* Subzone	*Lithraphidites acutum* Zone
	R				R							R		M	M	R		M	R	F	M	R	F	M	F	M	R	M	R		M	M		F	M	V	M		
	M	P			R							F		M	M	R		M	R	R	M	F	M	F	F	C		M	R		M	M		M	M	V	M		
	M	R									F	R		M	M	R		M	R	F	M	F	M	M	F	M	R	C	R		M	M		M	M	V	F	*Prediscosphaera spinosa* Subzone	*Eiffellithus turriseiffeli* Zone
	F	R			R						R	F		M	M	R		M		R	M	F		M	F	M	F	M			M	M		R	M	V	F		
	M	P			R					P	P	F		M	M	M		M	R	R	M	M		C	M	M	F	C	F	P	M	M		M	M	V	M		
	M	P			F						R	R		M	M	R		M		F	M	F	F	M	M	M	F	M	P		F	M		F	M	V	M		
	M	R									P	F		M	M	R		M	R	M	M	M	F	M	M	M	F	M	R	R	M	M		F	M	A	M		
	M	R			P					R	P	F		M	M			M	R	M	M	M	R	M	M	M		C	R		M	M		M	M	A	M		
	F				R							F		M	M	F		M	R	M	M	M	F	M	M	M	R	M		P	M	M		M	F	V	M		
	M									R	P	F		M	M	R		M		M	M	M	R	M	F	M	R	C	R		M	M		M	M	V	F		
	M										P	R		M	M	R		M	R	F	M	M	R	M	M	M	R	C	F		M	M		M	F	V	F		
	M										R	R		C	M	R		M		F	M	M	F	M	M	M		C	R		M	M		F	M	A	R		
	M									M		R		M	M	P		M	F	M	M	F	R	M	M	M	R	C	R	F	M	M		M	M	V	R		
	F									M		R		M	M	R		M	F	M	M	F	F	M	M	M	M	V	F	R	M	M		M	M	A	R		
	F										R	R		M	M	F		M	R	M	M	M	F	M	M	C	F	M	R		M	M		F	M	A			
	M	P								F	R	R		M	M	F		M	M	F	M	F	R	M	F	M	F	C	R	P	M	M		M	F	A	R		
	F							r		M		R		M	M	R		M	R	F	M	F	F	M	F	M	F	M	F		M	M		M	F	A			
	F									M	P	R	R	M	M	F	R	M	R	R	M	F	F	M	F	M	F	C	R	R	M	M		M	M	A			
R	R									F		R		M	M	R	R	M		F	M	R	F	M	F	M	M	C	P	P	M	M		M	F	V		*Hayesites albiensis* Subzone	
M	F									F	P			M	M	R	P	M		P	M	F	M	M	R	M	M	C	F		M	M		M	F	V			
M	M									F		R		M	M	R	R	M		R	M	M	F	M	R	M	M	V	M		M	M		M	M	A			
M	F									M		R		M	M	R		M		F	M	F	M	M	R	M	M	V	R	F	M	M		M	M	V	R		
	F													M	M	R	P	M	R	F	M	F	F	M	R	M	M	C	R	P	M	M		M	F	C	F		
F	M									F	P			M	M	F	P	M		F	M	F	F	M	F	M	M	C	R		M	M		M	F	V			
	M									F		M	R	M	M	R	R	F	R	R	M	M	F	M	F	C	R	A	M	R	F	M		F	R	A	F		
	R	P										F	R	M	M	R	R	R			M	F	F	M	F	M		V	M		F	M		F		V			*Prediscosphaera cretacea* Zone
	R	P										M	R	F	M	P	F				M	F	F		R	M		V	M		F	M		M	R	A			
	P	R								R		M		F	M	R	F	F			M	M	F	R	R	M		A	M		F	C		M	R	A			
R	R	P								F		M	R	F	M	R	R				M	M	F	P		M	F	V	M	M	C	M		M	R	V			
	R	P										F	R	F	M		F		R		M	F	F	R	R	M		C	M	F	M	M		M	F	C			
	F											F	R	M	M		F	F			M	F	F			M	F	V	M	F	M	M		R		V			
	F	R								F		R	F	M	M	R	F	M			M	M	F			M	F	V	M	F	M	M		M		A			
	R	P								F		F	R	R	M	R	M		R		M	F	F	P	R	M	M	C	M	R	M	M		F		V			
	R	R				p				F		M	F	F	M	F	F	F	M	P	M	M	F			M	M	V	M	F	M	M		M		V			
	R	R								F		M	R	F	M		M		F		M	M	F			M	M	A	M	F	M	M		M	R	A			
	R	R										F		F	M	R	F	F	F		M	M	F			M	M	V	M	R	M	M		M		A			
		F								M		M	R	R	M		M		M		M	M	F	R	R	M	M	A	M	M	M	M		M		A			
		R										F	F		M	R	F		M		M	M	F		R	M	F	C	M	F	M	M		M		V			
		R										M	F	R	M	R	F		M		M	M	F		R	M	M	A	M	M	M	M		M		A			
												R	R	R	M	R	F		F	R	M	M	F		R	M	M	C	M	F	M	M		M		V			
		R				p						M	R	F	M	R	M		M		M	M	F		R	M	F	A	M		M	M		M		A			
		F										F	R	M	M	F	M	F	M	P	M	M	F		M	M	M	V	M	M	M	C		M		A			
	R		p									M	F	F	M	R	M	F	M		M	M	F		F	M	M	A	M	F	M	M		M		A			
		F								P		M	R	P	M	R	M	F	M		M	M	R		R	M	M	V	M	R	M	M		M		V			
		F										M	R	F	M	R	F	F	M	R	M	M	F		F	M	M	V	M	F	M	M		M		A			
		R				p				M		M	R		M		F		F		M	M	F			M	R	A	M	F	M	M	F	M		A			*Rhagodiscus angustus* Zone
										F		R			M		M		R		M	M				M	R	C	F	F	M	M	R	F		C			
	P	R								M		M	F		M		M		F	R	M	M	F			M		A	M	R	M	M		M		V			
		F						R		M		M	R		M		M	R	R	R	M	F	F			M	R	V	M		M	M	F	M		V			
		R								M		M	R		M		F	F			M	M	F			M	F	V	M	F	M	M	F	M		V			
	R	R						F	R	M		F	F		M		M	F	M	F	M	M	M			M	F	V	M	R	M	M	M	F		A			
		F								M		F	F		M		M		R		M	F				M	F	C	M	M	M	M	M	M		V			
	P	F						P		F		F	R		M		F		R		M	M	R			M	F	V	M	F	M	M	F	M		V			
		F								M		R	R		M		F		R		M	F	F			M	R	V	M	F	M	M	F	F		V			
		R						R	R	M		R	R		M		R		R		M	M	F			M	F	V	M	F	F	M	F	M		V			
		F							R	M		F	F		M		F		R		M	M	R		P	M	F	C	M	M	F	M	R			V			
		R								F		F	F		M		F		R		M	M	R			M	F	C	M	R	M	M	R	M		V			
		F						R	R	M		M	R		C		M	R	R	R	M	F	R		R	M	F	V	M	F	F	M	R	F	R	A			
	R	M		R				M	M	M		R	R		M		M	F	M	F	M	M	M		R	M	M	V	M	F	M	M		M	P	A			
	P	R		R				M	M	M		F	F		M		M	M	M	M	M	M	F		R	M	M	V	M	M	M	M	R	M		A			
		F					P	R	R	M		F	R		M		F	R	F		M	M	R		P	M	R	V	M		M	M		M		V			
		F						R		M		F	R		M		F		R		F	R	R		P	M	F	C	M	F	F	M		F		V			
		R						M	F	M		R	R		M		R	R	R	R	F	F	F		P	M	F	C	M	F	M	M		F		C			
		R						R	R	M		R	R		M		R	R	M		M	F	F			M	M	A	M	M	M	M	P	F		V			
		R				p		M	F	M		F	R		M		M		M	R	M	M	F		R	M	M	V	M	M	M	M	F	M		V			
		M				r		F	R	M		M	M		M		M	M	M	R	M	M	M		F	M	M	A	M	M	M	M	F	M		V			
	P	F	R					M	F	M		F	R		C		M		F	M	M	M	M		R	M	M	V	M	M	M	C		F		V			
	R	F						F	F	M		F	M		C		M	R	M	F	M	M	F		F	M	F	V	M	M	M	M	R	M	P	V			
	R	F	R	R				M	M	M		M	F		C		M	F	M	F	M	M	M		F	M	M	V	M	F	M	M		F		V			
	R	F	R					F	R	M		M	F		M		M	R	M	R	M	M	F		F	M	F	V	M	M	M	C	F	F		A			
		M	R					R	R	M		M	M		C		M		F		M	M	F			M	F	A	M	M	M	C	M	F		V			
	R	F	R					F	R	M		M	M		C		M		R	R	M	M	F		R	M	M	A	M	M	M	C	M	M	R	A			
	R	M	R					M	R	M		M	F		C		M		R	R	M	M	M		F	M	M	A	M	F	M	C	F	F		V			
	R	R					R	F	R	M		M	F		M		F		R	R	M	M	M		R	M	F	V	M	F	M	C	F	M		V			
	R	F					P	M	R	M		M	F		C		M	M	R	R	M	M	M			M	M	V	M	M	M	C	F	M		V			
		F								M		M	R				M	F		R	M	M	M			M	M	V	M	M	M	M	F	M		V			
	R	F								C		M	F				M				M	M	F		R	M	M	A	M	F	M	M	F	M		A			
	R	M								M		M	R				M				F	M			R	M	M	V	M	M	M	M	F	M		C			
																												M	R		R	R	F					? ? ? ? ? ? ? Jurassic	

Table 3. Distribution of Cretaceous nannofossils in Holes 547A and 547B.

Core-Section (interval in cm)	Preservation	Abundance	Ahmuellerella octoradiata	A. regularis	Amphizygus brooksii	Arkhangelskiella cymbiformis	A. specillata	Axopodorhabdus albianus	A. dietzmanni	Bidiscus ignotus	Biscutum ellipticum	B. sp.	Braarudosphaera africana	B. hockwoldensis	B. minuta	B. stenorheta	Broinsonia lacunosa	B. parca	B. signata	Calculcalathina oblongata	Ceratolithoides aculeus	C. kamptneri	Chiastozygus garrisonii	C. litterarius	C. sp.	Conusphaera mexicana	Corollithion achylosum	C. geometricum	C. rhombicum	C. signum	C. sp.	Cretarhabdus conicus	C. crenulatus	C. loriei	C. surirellus	Cribrosphaerella ehrenbergii	Crucicribrum anglicum	Cruciellipsis chiastia	C. cuvillieri	Cyclagelosphaera margerelii	Cylindralithus biarcus	C. serratus	Diadorhombus rectus	Diazomatolithus lehmani	Discorhabdus biradiatus	Eiffellithus eximius	E. trabeculatus	E. turriseiffeli	Eprolithus floralis	Flabellites biforaminis	Gartnerago obliquum	G. striatum	Grantarhabdus coronadventis	Hayesites albiensis	Kamptnerius magnificus	Lithastrinus grilli	L. sp.	Lithraphidites acutum eccentricum
Hole 547A																																																											
32-4, 67 cm	G	V		M		M	M														M	F		M								F	R		M	M						M						M							P			
32-4, 70-73 cm	G	F		F		M	F														R	F		F								R			M	M						R						F										
32-4, 76-77 cm	M	F				F	R					R									R	P		P	R										F	R												R										
32,CC (16 cm)	M	A	M	M		C															M	M		M								F	R		M	M						M						M										
33-1, 16 cm	G	A	F	M		M	F			R	F	R									C	M		M								M	F		M	C						M						C										
33-1, 86-87 cm	M	V		M		M						R									M	R		R								R	R		M	M						M						M							P			
33-2, 45-46 cm	M	C		R		M		p													M			R								R	R		M	M						M						F							R			
33-2, 139-140 cm	G	A	F	M		C															M			F								F	M		M	M						M						M							F			
33-3, 29-30 cm	G	A		M		C	R				M										C			M								R	M		M	C						M						M							R			
33-3, 126-127 cm	G	V	F	M		M	M			F											C			M	R							M	F		M	C						M						M			M				R			
33-4, 45-46 cm	G	V	M	M		M	M		f	M	M	M									C			M	F				p			M	F		M	C					M	M					M	M			M				M			
33-4, 119-120 cm	G	V	F	M		M	M			M	M	M									C			M								F	M		M	M					M	M						M			M				M			
33-5, 49-50 cm	M	V	M	M		M	F			M	M										M			M								F	M		M	C					M	M					F	M			M				M			
33-5, 117-118 cm	M	C	M	M		M	M			M	M										M			M	R							F	M		M	M					M	M					M	M			M				M			
33-6, 111-112 cm	G	V	F	M		M	M			M	M										M			M	R							F	M		M	C				R	M	M					M	M			M				M			
34-1, 63-64 cm	M	C	M	M		M	F			M	M										M			M	F					P			M		M	M					M	M					M	M			M				M			
34-2, 55-56 cm	M	C		M		M	F			F	M										M			M									M		M	M					M	M						F			M				R			
34-2, 120-124 cm	G	A	M	M		M	M			M	M										C			F								F	M		M	V					M	M					F	M			M				R			
34-3, 83-84 cm	G	C	M	M		M	M			M	M										M			M	M							F	M		M	M				R	M	M				r	M	M			M				R	p		
34-4, 100-101 cm	G	V	M	M		M	M			M	M										M			M	R							F	M		M	C					M	M				r	M	M			M				R			
34-5, 82-83 cm	G	V	M	M		M	M			M	M										M			M								F	M		M	C					M	M					F	M			M							
34-6, 95-96 cm	G	V	M	M		M	M			M	M							r			M			M	M					P		F	M		M	C					M	M				r	F	M			R				F			
34-7, 14-15 cm	G	C	F	M		M	M			M	M										M			M	R							F	M		M	M				F	F	M					R	M			M							
35-1, 67-68 cm	M	V	R	F		M	F			F	M							M			M			F								R	M		M	M					R	M						F			F				M	M		
35-2, 132-133 cm	M	V		F		F	M			F	M							M			M			F	F								F		M	C						M				P		R			M				M	F		
36-1, 26-27 cm	G	V	R	M	p	F	F	f		M	M						M	M			M			F	F		r			M		R	F		M	M				R	M	M				M	R	M			M				M			
36-2, 82-83 cm	G	C		F		F	R	f		M	M						M	M			M			M	F		f			F			R		M	M		p				M				M	P	M			R							
36-3, 6-7 cm	P	C	R	R		M	R			F	M						F	M			M			F	F								F		M	M						M				M		M			M				R			
37-1, 65-66 cm	M	V	F	F		M	R			M	M							M			M			F	M					R			M		M	M					M	M				R	F	M			M				M	R		
37-2, 16-17 cm	M	V	R	M		R	M			M	M							M			M			F	M							F	F		M	M					M	M				M	R	M			M					R		
37-3, 20-21 cm	P	V	R	M		M				M	M							M			M			R	M							R	F		M	M				R	M	M				M		M			M				R	F		
37-4, 65-66 cm	M	F	F	M		R	R			F	M						R	M			M			M	M								F		M	M					M	F				M					M				R	R		
38-1, 134-135 cm	M	V	R	M			R			F	M						M	M			M			M	M							R	F		M	M				R	F	M				M	R	M			M	F			R			
38-2, 130-131 cm	M	V	R	M		P	F	r		F	M						F	M			M			M	M					R			M		M	M					M	M				M		F			M	R			R	R		
38-3, 12-13 cm	M	V	M	M		R	F		R	M	M							M			M			M	M					R		F	M		M	M					M	M				M		M			M	M			R	R		
39-1, 10-11 cm	G	V	R		R	R	R	M	M	M	A							R			R		M	M	F		M	M	F	M	F	R			M	M		R		R							R	M	R	R	M	R	R				R	P
40-1, 70-71 cm	G	V			R			M	M	M	A		p										M	M	M		M	M	F	M	M	R	F	R	M	M		R		M							M	M			R		F				R	R
40-2, 70-71 cm	G	A						M	F	M	A												M	M	M		M	M	F	M	M		R	R	M	M		R									R	M	F		R		R				P	R
41-1, 77-79 cm	G	A			F			M	F	M	A												M	M	M		M	C	R	C	M		R		M	M		R		M							R	M	R	F	R		R				R	R
41-2, 48-50 cm	G	A			F			M	F	M	A												M	M	F		M	C	M	C	M	R		R	M	M		R		M							R	M	M	F	R		R				F	R
42-1, 20-21 cm	G	A						M	R	M	A												M	M	F		M	C	F	C	M	R	R	P	M	M		R		M							R	M	F	R	F		F				R	R
42-3, 20-21 cm	G	V			R			M	R	M	A	R											M	M	M		M	C	F	C	M	R	R	R	M	M		F		F							F	M			F		R				R	F
43-1, 20-21 cm	G	V			R			M	R	M	A												M	M	M		M	C	F	M	M	R	R	R	M	M		R		M								M	F	F	M		F				P	R
43-3, 20-21 cm	G	V						M	R	M	A												M	M	M		M	M	R	M	M				M	M		R		M								M	M	R			F				R	F
44-1, 52-53 cm	G	V			F			M	R	M	V	R											M	M	F		M	M	F	C	M	F			M	M		R		M							F	M	R	R	R		F				F	F
44-3, 52-53 cm	G	V			F			M	R	M	A	F											M	M	F		M	M	M	M	M			R	M	M		R		M								M	R	P	R		F				R	R
44-5, 52-53 cm	G	V			M			M	F	M	A												M	M	M		M	C	M	M	M				M	M				F								M	R	R	R		R				R	P
45-1, 17-18 cm	G	V			M			M	F	M	A												M	M	F		M	C	F	M	M	R		P	M	M		R		M							F	M	F	M	R		F					R
45-3, 17-18 cm	G	V			F			M	R	M	A												M	M	F		M	C	F	M	M	R		P	M	M		P		M							F	M	F	F	F		R				R	R
46-1, 32-33 cm	G	V			F			M	F	M	A												M	M	M		M	C	F	M	F	M		P	M	M		P		M							R	M	F	F	R		F				F	R
46-2, 32-33 cm	G	A			F			M	R	M	A												M	M	M		F	M	F	M	F	R		R	M	M		R		M							R	M	F	R	R		R				R	P
46-3, 32-33 cm	G	A			F			M	F	M	A	R											M	M	M		M	M	F	M	M	F		F	M	M		F		M							F	C		P	F		F				R	
47-1, 77-78 cm	G	C			R			M	R	M	A												M	F	M		M	M	F	M	M	M			M	M		R		M							M	M	M	F	R		P				F	
47-3, 77-78 cm	G	A			F			M	R	M	A	P											M	M	M		M	C	M	C	M	R		R	M	M		R		M							F	M	F	F	F		R				F	
48-1, 102-103 cm	G	C			R			M	R	M	V												M	M	M		F	M	R	M	F	F		F	M	M	R	R		M							R	M	F	F	F		R				F	
49-1, 77-78 cm	G	C			P			M	R	M	V	R											F	M	F		M	M	R	M	R	P		P	M	M	R	R		F							R	M	F		F		F					
49-3, 18-20 cm	G	A			R			M	M	M													M	M	M		M	M		M	M	M		F	M	M		F		M							M	C	F	F	M		M					
50-1, 32-33 cm	G	C			R			M	R	M	V	F											M	M	F		M	M	F	M	M	F		P	M	M	F	F		M							F	M	F	F	R						R	
50-3, 32-33 cm	G	C			R			M	R	M	V	R											M	M	M		M	C	M	M	M	R		R	M	M	R	F		M							M	M	F	F	F						R	
51-1, 77-78 cm	G	C			F			M	F	M	V	R											M	M	M		M	M	M	M	M	F			M	M		F		M							F	M	F	P	R		R				F	
51-3, 77-78 cm	G	C			F			M	F	M	V												M	M	F		M	M	F	M	M	R		R	M	M	R	F		M							R	M	F	F	F		R				R	
52-1, 77-78 cm	G	V			M			M	F	M	V												M	M	M		M	C	F	M	M	F			M	M	R	F		M							F	M	R		R		R				R	

Note: D = very abundant; A = abundant; V = very common; C = common; M = moderately common; F = few; R = rare; P = present; E = essentially barren; B = barren. Quantitative estimates for these symbols are given in the text. For preservation, G = good; M = moderate; P = poor, as defined in the text.

DISCUSSION

Legs 14, 41, and 50 of the Deep Sea Drilling Project recovered Cretaceous sediments in the vicinity of Leg 79 (Fig. 1). The sites drilled were Site 135 (Leg 14); Site 370 (Leg 41); and Sites 415 and 416 (Leg 50). Figure 3 shows the correlations among these holes and the Leg 79 holes. Any differences among datums or in the ranges of zones that the correlation is based upon are noted in the discussion that follows.

Site 135, drilled on a topographic high, recovered poor Upper Cretaceous assemblages, which were assigned a late Campanian–early Maestrichtian age (*Tetralithus gothicus trifidus* Zone) by Roth and Thierstein (1972). This zone corresponds to the *Quadrum trifidum* Zone used herein. Lower Albian sediments that correlate to the *Chiastozygus litterarius* Zone were also recovered.

Site 370 was drilled in a deep basin off Morocco. The Cretaceous interval at this site, lower Valanginian to upper Albian (Čepek, 1978), is somewhat sporadically dated, since unconformities and unzoned intervals are present. Čepek used a Lower Cretaceous zonation similar to that of Thierstein (1973).

Site 415 (Hole 415A) is located in the Agadir Submarine Canyon, south of Sites 370 and 416. Čepek et al. (1980) assign these Cretaceous sediments to the *Lithraphidites alatus* and/or *Eiffellithus turriseiffeli* zones of Cenomanian to late Albian age but question the presence of the *L. alatus* Zone within the interval because only a few *L. alatus* occurred in one sample. The inter-

Table 3. (Continued).

L. alatus	*L. carniolensis*	*L. helicoideus*	*L. praequadratus*	*L. quadratus*	*Lucianorhabdus* sp.	*Manivitella pemmatoidea*	*Markalius astroporus*	*M. inversus*	*Marthasterites furcatus*	*Microrhabdulus belgicus*	*M. decoratus*	*Micula concava*	*M. decussata*	*M. mura*	*M. prinsii*	*Nannoconus colomii*	*N. quadriangulus*	*N. quadriangulus apertus*	*N. truitti*	*Octocyclus reinhardtii*	*Parhabdolithus embergeri*	*P. infinitus*	*Prediscosphaera cretacea*	*Quadrum gartneri*	*Q. gothicum*	*Q. nitidum*	*Q. trifidum*	*Reinhardtites anthophorus*	*Retecapsa schizobrachiata*	*Rhagodiscus angustus*	*R. asper/splendens*	*Rucinolithus irregularis*	*Scapholithus fossilis*	*Seribiscutum* sp.	*Sollasites horticus*	*Speetonia colligata*	*Stephanolithion laffittei*	*Stradnerlithus* sp.	*Tetralithus* sp.	*Tetrapodorhabdus decorus*	*Tranolithus gabalus*	*T. orionatus*	*Vagalapilla matalosa*	*V. stradneri*	*Vekshinella angusta*	*Watznaueria barnesae*	*W. biporia*	*W. britannica*	*Zeugrhabdotus erectus*	*Zygodiscus diplogrammus*	*Z. spiralis*	*Z.* sp. 2	*Z.* sp. 3	*Z.* sp. 4 (small)	Gen. et spec. indet. 1	Zones	
			M	M		M	P			R	M	M	C	M	M						R		M						R		F									M				F		V	F				M	F				FOD *Micula prinsii*	*Micula mura* Zone
				R		R					F	M	C	M	M								M						M											R			P			M	M				M	R					
							F				R	R	M	M									F						R															F		M					M	F					
			M	M							M	M	V	F	M						M		C						R		R									M		r		M		V	F				M						
	R		C	M		M	R				M	M	V								M		V						P	f	F									M				M		V	F				M	F					
	M	F	M	M		F					M	F	C	M							M		M						R					F					F	F			R	F		V	M				M					FOD *Ceratolithoides kamptneri*	
	M	F	M	M		F	P				F	M	C	F							R		M							r									M							C	F				M						
	M	F	M	M		M					M	M	V	F							M		M								R								M	R		r				V	M				M	R					
	M	F	M	M		M					M	M	V	F							M		C						R								R		M			p		F		V	M				M	F					
	M		M	M		M					M	M	V	F							M		C							M									M	M			R	M		V	M		R	R	M	F					
	C	M	M	M		M	R			P	M	M	C	R							F		V						F	F	M									M				M		V	M			R	M	M					
	M	M	M	M		M					M	F	V	R							F		C						F		R								R	M		P		M		V	M				M	F					
	F	R	M	M		M					M	M	V								M		V						M	R	M									M		R		M		A	M				M	F				*Lithraphidites quadratus* Zone	
	M	M	M	M		M					M	M	C								M		C						R	R	M								R	M		R		M		C	M				M	R					
	M	M	M	M		M				R	M	F	C								M		C						F	R	M								R	M		R		M		V	F				M	R					
	M	F	M	M		M				R	M	F	C								M		M						M		M									M		F		M		V	M				M						
	F	F	M	F		M				P	M	M	V								M		M						F		R								R	F		R		M		V	M				M	R					
	M	M	M	F		M					M	M	V								M		C						M		M									M		R		M		A	M			R	M						
	M	M	M	R		M					M	M	C								F		C			p			F		F									F		R		M		C	F		R		M						
	M	M	M	R		M					M	M	V								M		C		r		r		M	R	F						F			M		R		M		V	M			F	M						
	M	M	M	R		M				R	M	M	C								M		C					M	M		M						M			M				M		C	F			R	M						
	F		M			M			p		M	M	C								R		C		P			M	R		R				f		R			M				M		C	F		R	M	M	R					
	M	F	M	R		F					M	M	C								M		M					M	R											F		R	P	M		C	F			M	M						
	M					M					M	M	M										M	M	F		M	M	M													F				V	M				M					*Quadrum trifidum* Zone	
	M					M					M	M	V								M		M	M	M		M	M	F		R											M		F		A	M		R	F	M						
	M					M					M	F	V								M		C	M	M		P	M	R		P		r							F	R	M	M	M		V	M		F	M	M	R	R				
	M					F					F	M	V								M		M	M	M			M							p		F				P	M	R	F		V	M		M	M	M		M	M		*Quadrum gothicum* Zone	
	M					M					F	M	V								M		M	F	R			M														M		R		V	M		M	M	F						
	M					M				R	M	M	V								M		C	M	M			F	R		R						P			F	R	M		M		A	R		R	M	F						
	M					M					M	M	V								M		V	M	M			M	R		R						R			M		M		R		A	M		R	M	M						
	M					M		F			M	F	C								M		C	M	M			M			R			P						F	R	M		F		A	M			M	F						
	F					M					M	M	C										M		R			M													R	F		R		C	M		M	M	F	R					
	F					M					R	M	V								F		M					M									F			R	P	M		F		A	M		M	M	F		P			*Ceratolithoides aculeus* Zone	
	F					M					M	M	V								R		M					M													R	M				A	R		F	M	M	R					
	M					M					M	M	V								M		C					M			R				R		M			M	R	M		R		A	M		M	M	M	F	P				
	M					M		R				R	M							P	M		M							M	M		M	F			M			F	M	M	M	M		C	R	R	M	M	R	R	F	V	M	*Cruciellipsis chiastia* Subzone	*Lithraphidites acutum* Zone
P	M					M		R												R	M		C							M	M		M		R		M			M	F	M	M	M	R	C	M		M	M			R	A	M		
P	M					M														F	M		M							M			M	R	M		M			M	M	M	M	C	R	C	R	F	M	M		R	R	V	F		
R	C					M		R													M		C							M			M	R	M		M			M	F	M	M	C		C	M		M	M		F	M	A	M		
R	C					M		P													M		M							M			M	R	M		M			M	M	M	M	C	F	V	M	P	M	M		F	F	A	M		
P	C					M				R										R	M		M							M			M	F	M		C			M	F	M	M	C		C	F	F	M	M		M	M	A	M		
P	M					M														R	F		M							M			M	R	M		M	R		M	F	M	M	C	R	C	M		M	M		M	M	V	M		
P	C					M		R													M		M							M			M		M		C	R		M	M	M	M	C	R	C	M		M	M		F		V	F		
R	M					M															M		M							M			M	R	R		C			M	M	M	M	C		C	M	R	M	M		F		V	M		
P	M					M		P												R	F		M							F			M	R	F		M	F		M	M	M	M	C		C	M	R	M	M		M	M	A	F		
	M					M		R		R									P	P	F		C							M			M	P	M		M	F		M	M	M	M	C	R	M	F		M	M		M	M	A	M		
	C					M		P		R										R	F		M							M			M	P	M		M	R		M	M	M	M	M		C	F	P	M	M		F	M	A	M		
	M					M				R										P	F		M							M			M		M		M	R		F	M	M	M	M		C	F		M	M		F	M	V	M		
	M					M		P												P	F		M							M			M	F	F		M	R		F	F	M	M	M		C	F		M	M		M	M	V	F		
R	M					M		P													F		M							M			M		M		M	M		F	F	M	M	M		C	R	P	M	M		M	M	V	F		
R	C					M		R												P	F	p	M							F			M	P	M		M	R		F	F	M	M	M		C	F	R	M	M		M	M	A	M		
R	M					M		R		P										P	M		C							F			M	R	F		M			F	M	M	M	C	R	C	M	R	M	M		M	M	A	M	*Prediscosphaera spinosa* Subzone	*Eiffellithus turriseiffeli* Zone
R	M					M		R												P	F		M							F			M	P	R		M			F	M	M	M	M		M	M		M	M		F	M	A	F		
	M					M		R												P	F		C							M			M		M		M			M	M	M	M	C		M	M	P	M	M		F	M	A	F		
P	M					M															F		M							M			M	R	M		M			M	M	M	M	M	R	M	F	P	M	M		R	M	V	F		
	M					M		R		R											M		M							F			M		M		M			F	M	M	M	M	F	M	M	P	M	M		M	M	V	F		
R	C					M		R												P	M		C							M			M		M		M			M	M	M	M	C	F	V	M	F	M	M		M	M	D	M		
P	M					M		R		R											F		M							M			M		M		M			F	F	F	M	M		M	M		M	M		F	M	A	M		
R	C					M				F										R	R		M							M			M	F	M		M	F		F	F	M	M	M		M	M	R	M	M		M	M	V	F		
R	M					M															R		M							M			M		M		M	R		M	F	M	M	M	R	M	F		M	M		F	M	V	M		
	M					M		F		R										R	F		M							F			M	R	M		M			F	M	M	M	M		C	M	R	M	M		F	M	V	M		
	M					M				F							R				F		M							F			M	R	M		M	F		M	M	M	M	M	R	C	M	R	M	M		R	M	A	F		

val from the *L. alatus* to the *E. turriseiffeli* zones corresponds approximately to the *L. acutum* and *E. turriseiffeli* zones of Manivit et al. (1977).

Hole 416A was drilled in the Morocco Basin very near Site 370. The hole has a limited Albian–lower Aptian section (Čepek et al., 1980) with several barren samples between the short mid-Albian and lower Aptian intervals. The zones used for this short interval are those of Thierstein (1973). The upper Hauterivian–lower Valanginian section is greatly expanded because it is within a turbidite sequence. Čepek et al. (1980) place this section in the *Cretarhabdus crenulatus* to *L. bollii* zone (Thierstein, 1973).

Site 135, the most northern site, contains a poor nannofossil assemblage of Campanian–Maestrichtian age. In comparison, the lower Campanian to Maestrichtian of Hole 547A has a larger sediment sequence with a higher diversity of nannofossil species and better defined zones.

The mid-Cretaceous, including the Cenomanian to Aptian, is represented at all the sites. Some sites, such as 415 (Hole 415A) and 135, have few nannofossil zones represented within a considerable sedimentary sequence, whereas others appear to have a continuous record of nannofossil stratigraphic events, as at Sites 545 and 547 (Holes 547A and 547B).

Only Site 370 contains coccoliths of Barremian age. The sediments of this site range from early Valanginian to late Albian in age, with some apparent unconformities and unzoned intervals present. The nannofossil assemblages of Hole 416A are late Hauterivian to early Valanginian in age, and were deposited within a large

Table 3. (Continued).

Core-Section (interval in cm)	Preservation	Abundance	*Ahmuellerella octoradiata*	*A. regularis*	*Amphizygus brooksii*	*Arkhangelskiella cymbiformis*	*A. specillata*	*Axopodorhabdus albianus*	*A. dietzmanni*	*Bidiscus ignotus*	*Biscutum ellipticum*	*B.* sp.	*Braarudosphaera africana*	*B. hockwoldensis*	*B. minuta*	*B. stenorheta*	*Broinsonia lacunosa*	*B. parca*	*B. signata*	*Calcicalathina oblongata*	*Ceratolithoides aculeus*	*C. kamptneri*	*Chiastozygus garrisonii*	*C. litterarius*	*C.* sp.	*Conusphaera mexicana*	*Corollithion achylosum*
Hole 547A (Cont.)																											
52-3, 77-78 cm	G	C			F			M	F	M	A												M	M	M		M
53-1, 77-78 cm	G	V			F			M	R	M	A												M	M	M		M
53-3, 16-18 cm	G	V			F			M	F	M	A												M	M	M		M
54-2, 50-51 cm	G	V						M	F	M	V												M	M	M		M
55-1, 50-51 cm	G	V			R			M	F	M	V	R	P										M	M	F		M
55-3, 50-51 cm	G	V			M			M	R	M	A	P		F									M	M	M		M
56-1, 94-96 cm	G	V			R			M	R	M	A	R											M	M	M		M
56-3, 94-96 cm	G	V			R			M	M	M	A	R											M	M	M		M
57-1, 77-78 cm	G	C			R			F	F	M	A	R											M	M	R		M
57-3, 77-78 cm	G	C			R			F	F	M	V	R											M	M	M		M
57-5, 77-78 cm	G	V			F			M	F	M	A	F											M	M	M		M
58-1, 77-78 cm	G	C			R			M		M	A	P							M				M	F	R		M
58-2, 0-2 cm	G	C			F			M	F	M	V	R							M				M	M	F		M
58-4, 77-78 cm	G	V			P			M	F	M	A	P							F				M	M	M		M
59-1, 77-78 cm	G	C			P			M	F	M	V	P							F				F	M	F		M
59-3, 77-78 cm	G	V						M	R	M	A	R							F				M	M	F		M
59-5, 77-78 cm	G	A			R			M	F	M	A	M							F				M	M	M		M
60-1, 77-78 cm	G	V			F			M	R	M	V	R		P					R				M	M	M		M
60-3, 77-78 cm	G	V						M	F	M	A	R											M	M	F		M
60-5, 27-28 cm	G	V						M	R	M	V	F							R				M	F	M		M
61-1, 77-78 cm	G	V			F			M	F	M	V	P							P				M	M	M		M
61-3, 77-78 cm	G	V			R			M	F	M	V	R											M	M	M		M
62-1, 77-78 cm	G	C						M	R	M	V			F									M	M	M		M
62-2, 77-78 cm	G	C						M	R	M	V	R											M	M	F		M
63-1, 77-78 cm	G	C			R			R	P	M	C	F							P				M	M	R		F
63-2, 77-78 cm	G	V			F			R	F	M	V	M							P				M	F	F		M
64-1, 77-78 cm	G	C			R			R	F	M	V	M											M	F	M		M
64-3, 77-78 cm	G	C			F			R	F	M	V	F	R										M	M	F		F
65-1, 39-40 cm	G	C			R			R	F	M	V												M	M	M		M
66-1, 9-10 cm	G	V			P			F	F	M	V	F											M	R	M		F
66-3, 9-10 cm	G	V			R			M	R	C	V	M											M	M	M		F
67-1, 30-31 cm	G	V			R			R	R	M	V		P										M	M	M		M
67-3, 8-10 cm	G	V						M	F	M	V	R			P								M	M	M		F
68-1, 40-41 cm	G	C			R			F	F	M	V	F											M	M	F		F
68-3, 110-112 cm	G	C			P			R	R	M	V				P	P							M	M	F		F
69-1, 77-78 cm	G	C			R			R	R	M	C	P											M	F	M		F
69-3, 77-78 cm	G	C			R			R	R	M	V	P											M	M	R		F
70-1, 77-78 cm	M	C						P	F	C	V												M	F	R		R
70-3 77-78 cm	M	C			R			R	P	M	V	R											M	M	F		F
71-1, 42-43 cm	M	C			R			P	P	M	V												M	F	F		R
72-1, 77-78 cm	M	C						R	R	M	V												M	M	F		F
72-3, 77-78 cm	M	V						R	F	M	V												M	F	F		F
73-1, 92-98 cm	G	V			R			P	R	M	V	P											R	R	R		M
73-3, 92-93 cm	M	C			F			P	R	M	V		P	F	F								R	R	R		F
Hole 547B																											
2-1, 77-78 cm	G	C			P				P	M	V		R										F	F	F		M
2-3, 77-78 cm	G	C			R			R	R	M	V		P										F	R	F		M
2-5, 77-78 cm	G	C						P	P	M	V												M	R	F		M
3-1, 70-72 cm	G	C						P	P	R	C												R	R	R		R
3-3, 148-150 cm	M	V						R	R	M	V	R											M	M	F		F
3-5, 126-128 cm	G	V						P	R	M	A												M	M	M		M
4-1, 57-59 cm	G	C			F			F		M	V		F	P		R							M	F	F		F
4-3, 33-35 cm	G	C						M		M	V	P				P							M	F			M
4-5, 76-78 cm	G	V						F	P	M	V												P	F	F		F
5-1, 77-78 cm	G	V			R			F	R	M	V	P	P										R	F	M		F
5-3, 77-78 cm	G	C			P			M	P	M	V					P							R	F	M		F
5-4, 77-78 cm	M	V						R		M	V	R											R	F	M		R
6-1, 39-41 cm	G	V			P			M	R	M	V													F	F		F
6-1, 139-140 cm	M	C							M	F	M									F					F	R	
6-2, 6-7 cm	G	V							R	M	M									M						R	
6-3, 57-58 cm	P	F																									

Core-Section (interval in cm)	*C. geometricum*	*C. rhombicum*	*C. signum*	*C.* sp.	*Cretarhabdus conicus*	*C. crenulatus*	*C. loriei*	*C. surirellus*	*Cribrosphaerella ehrenbergii*	*Crucicribrum anglicum*	*Cruciellipsis chiastia*	*C. cuvillieri*	*Cyclagelosphaera margerelii*	*Cylindralithus biarcus*	*C. serratus*	*Diadorhombus rectus*	*Diazomatolithus lehmanii*	*Discorhabdus biradiatus*	*Eiffellithus eximius*	*E. trabeculatus*	*E. turriseiffeli*	*Eprolithus floralis*	*Flabellites biforaminis*	*Gartnerago obliquum*	*G. striatum*	*Grantarhabdus coronadventis*	*Hayesites albiensis*	*Kamptnerius magnificus*	*Lithastrinus grillii*	*L.* sp.	*Lithraphidites acutum eccentricum*
Hole 547A (Cont.)																															
52-3, 77-78 cm	M	F	M	M	F			M	M		M		M							F	M	F	R	R		R					
53-1, 77-78 cm	M	R	M	R	F			M	M	R	F		M							R	M	M		R		R				M	
53-3, 16-18 cm	M	R	M	M	F		P	M	M	R	M		R							R	C	M	F	F		M				F	
54-2, 50-51 cm	M	R	M	M	M		P	M	M	P	F		M							R	M	M	F	R		M				F	
55-1, 50-51 cm	M		M	F	M			M	M	R	F		M							F	M	M	R	R		F				M	
55-3, 50-51 cm	M	F	M	M	M		P	M	M	F	M		M								M	M	P	R		F				F	
56-1, 94-96 cm	M	F	M	M	M		R	M	M	F	M		M							M	C	F	R	R		F				F	
56-3, 94-96 cm	M	F	M	M	M		R	M	F		M		M							F	C	M	P	R		R				M	
57-1, 77-78 cm	M	R	M	M	M	R	P	M	M		M		M				R			R	M	F				R				R	
57-3, 77-78 cm	C	F	M	M	M			M	M	P	F		M							P	M	F	F			R				M	
57-5, 77-78 cm	C	F	M	M	M			M	M		M		M							R	C	M	R			R				M	
58-1, 77-78 cm	M	R	M	M	F			M	M	R	R		M							F	M	F	P	R		R				R	
58-2, 0-2 cm	M	R	M	M	M		R	M	M	R	F		M				P			R	M	F				R				R	
58-4, 77-78 cm	M	R	M	M	M			M	M	R	F		R							R	M	F	R			P				F	
59-1, 77-78 cm	M	M	M	M	F		P	M	M	R	F		M							R	M	F				F				F	
59-3, 77-78 cm	M	M	M	F	M		R	M	M	P	M		M								M	F	R							R	
59-5, 77-78 cm	M	R	C	M	F			M	M	F	M		M							R	C	M	M			M				M	
60-1, 77-78 cm	M	F	M	M	M		P	M	M	R	M		M							R	M	F				F				F	
60-3, 77-78 cm	M	F	M	M	M			M	M	P	M		F							R	M	M	R			R				P	
60-5, 27-28 cm	M	M	M	M	F			M	M		M		M							F	C	F	R			R				P	
61-1, 77-78 cm	C	F	M	M	M		R	M	M	P	M		M							R	M	M	R			F				R	
61-3, 77-78 cm	M	F	M	M	F			M	M	F	M		M							R	M	F	R			F				R	
62-1, 77-78 cm	M	R	M	M	M			M	F	P	M		M							R	M	F	P	P		F				R	
62-2, 77-78 cm	M	R	M	M	M		R	M	F	R	R		M							P	M	F				R					
63-1, 77-78 cm	M	P	M	M	F			M	M	P	M		M								M	M	R			R	R			R	
63-2, 77-78 cm	M	F	M	F	F		R	M	F	P	F		M							P	M	R	R			F	F			R	
64-1, 77-78 cm	M	R	M	M	F		R	M	M	R	R		M								M	R	F			R				R	
64-3, 77-78 cm	M	F	M	M	F		P	M	F	P	R		M							P	M	F	F	P		R	F				
65-1, 39-40 cm	M	F	M		R			M	F		R		M							R	M	M	F			P	R				
66-1, 9-10 cm	M	R	M	R	M		R	M	M		R		M								M		R	P		P	R				
66-3, 9-10 cm	M		F		F		R	M	R		R		M								M	R	R			F	R				
67-1, 30-31 cm	M	R	M	R	M			M	R				M								M	M	F			R	R				
67-3, 8-10 cm	M	R	F	R	M			M	M	P	M		M								M	R	F			F					
68-1, 40-41 cm	M	R	F		F		P	M	R	R	R		M							P	M	P	F			R	P				
68-3, 110-112 cm	M	R	M	P	F		R	M	F		R		M							R	M		R			P	P				
69-1, 77-78 cm	M	P	M	P	M		R	M	R	P	R		F							P	M	R	R			F	R				
69-3, 77-78 cm	F	P	M	R	M		R	M	F		R		M							R	M	R	R								
70-1, 77-78 cm	F		R		F		P	M	R	P	R		F							P	M	F	R			R	P				
70-3 77-78 cm	M	P	F	R	R		R	M	P	P	R		F							M	M	R	F			R	P				
71-1, 42-43 cm	F		F	R	R			M	P		F		F							M	M	R	R				R				
72-1, 77-78 cm	F	P	F	R	F		R	M	R	P	F		F							M	M	P	R			R	P				
72-3, 77-78 cm	M		M	F	F			M	R	P	R		F							M	M	F	F			R					
73-1, 92-98 cm	M	F	M	R	R			M	R		R		F								M	F	R			R					
73-3, 92-93 cm	M		M	R	R			M	P				M								F	F	P			P	F				
Hole 547B																															
2-1, 77-78 cm	M	P	M	P	F			M	R	P	R		F								M	M	R			P	R				
2-3, 77-78 cm	M	R	M	P	F			M	R		R		M							P	M	R	R			F	F				
2-5, 77-78 cm	M	P	M	P	R			M	R		F		M							R	M	M	R			R	M				
3-1, 70-72 cm	R	R	F		R			M	R		F										M	R	R			R	F				
3-3, 148-150 cm	F		M		M			M		R	M		M							P	M	M	F			R	F				
3-5, 126-128 cm	M	P	M		R		R	M	R		F		M								M	M	F			F	R				
4-1, 57-59 cm	M	P	M		R		P	M	R		R		F							P	M	M	F			P	P				
4-3, 33-35 cm	F		M		F			M	F	P	R		F								M	R	R			R	R				
4-5, 76-78 cm		P	M		R			M	R		R		M								R	M	P			R	F				
5-1, 77-78 cm	R		M		R	P	P	M	R	P			F								F	M	M			R	R				
5-3, 77-78 cm	F		M		F			M	R	R	R		M								R	M	R			M	F				
5-4, 77-78 cm	F	R	M		R			M	R	P	R		R								R	F	F			R	F				
6-1, 39-41 cm		M	M		F		R	M	R	P			M								P	R	R			F	F				
6-1, 139-140 cm	M				R	R	P	F			M	R	M			R	C	R					P								
6-2, 6-7 cm					F	F	P	F			M	M	C				M	R													
6-3, 57-58 cm													F																		

turbidite sequence. Sediments at Sites 370 and 416 were deposited in a basinal setting (Morocco Basin), as evidenced by the turbidites of Hole 416A and the relatively thickened sediment sequence, compared to Hole 547B, of Site 370. Hole 547B contains a limited sequence of lower Valanginian–lower Hauterivian sediment interbedded with limestone that was apparently deposited on the carbonate platform to the north of the other two sites.

All the sites studied have a major unconformity between the Albian or Cenomanian and the Upper Cretaceous (Sites 135 and 547) or the Tertiary (Sites 370, 415, 416, and 545). It appears that the sites (370 and 416) within the Moroccan Basin have unconformities separating the Tertiary from the middle or upper Albian. However, to the north, where sediments were not deposited at such great depths, the youngest sediments below the unconformity at Sites 545 and 547 are middle–upper Cenomanian. The major event (or events) that caused this widespread unconformity does not appear to have affected Sites 135 and 547 so severely as the others, since both have uppermost Cretaceous sediments present.

SUMMARY AND CONCLUSIONS

The Cretaceous sediments recovered on Leg 79 are predominantly middle and Upper Cretaceous in age, with a minimal amount of lower Valanginian–lower Hauterivian age sediments present. Only a small portion of the Cretaceous sediments has no recoverable record of nannofossils; this is in the lower Valanginian–lower Hauterivian of Hole 547B where limestones are present. However, claystones interbedded with the limestones do have nannofossils. The calcareous nannofossil assemblages for

Table 3. (Continued).

L. alatus	L. carniolensis	L. helicoideus	L. praequadratus	L. quadratus	Lucianorhabdus sp.	Manivitella pemmatoidea	Markalius astroporus	M. inversus	Marthasterites furcatus	Microrhabdulus belgicus	M. decoratus	Micula concava	M. decussata	M. mura	M. prinsii	Nannoconus colomii	N. quadriangulus	N. quadriangulus apertus	N. truitti	Octocyclus reinhardtii	Parhabdolithus embergeri	P. infinitus	Prediscosphaera cretacea	Quadrum gartneri	Q. gothicum	Q. nitidum	Q. trifidum	Reinhardtites anthophorus	Retecapsa schizobrachiata	Rhagodiscus angustus	R. asper/splendens	Rucinolithus irregularis	Scapholithus fossilis	Seribiscutum sp.	Sollasites horticus	Speetonia colligata	Stephanolithion laffittei	Stradneriithus sp.	Tetralithus sp.	Tetrapodorhabdus decorus	Tranolithus gabalus	T. orionatus	Vagalapilla matalosa	V. stradneri	Vekshinella angusta	Watznaueria barnesae	W. biporta	W. britannica	Zeugrhabdotus erectus	Zygodiscus diplogrammus	Z. spiralis	Z. sp. 2	Z. sp. 3	Z. sp. 4 (small)	Gen. et spec. indet. 1	Zones
R	M					M				P											F		M							F			M		M		M			M	M	M	M	M		M	M	R	M	M		M	F	V	F	
P	C					M		P													F		M							F			M		M		M			M	F	M	M	M		M	M	R	M	M		F	F	A	I	
R	M					M		F		P											M		M							F			M		M		M			M	M	M	M	C		V	M	F	M	M		F	F	A	M	
R	M					M		R													F		M							M			M	R	M		M			M	F	M	F	M	R	C	M	R	M	M		M	R	A	M	
R	M					M		M		R									P	P	M		M							F			M	R	M		M			M	M	M	M	M	R	C	M	R	M	M			M	V	F	
	M					M		R											F		R		M							F			M		M		M			M	M	M	M	M		C	M		M	M		M	F	V	M	
P	M					M		F												R	M		M							M			M	R	M		M			M	M	M	M	M		C	M	F	M	M		M	F	A	M	
P	M					M		R		P										R	M		M							F			M	R	M		M			M	M	M	F	M	R	C	M	F	M	M		M	M	V	M	
R	M					M		R		P											F		M							F			M	R	M		M	R		M	F	M	M	M	R	M	F	F	M	M		F	M	V	M	
R	M					M		F		R											F		M							F			M	P	M		M			M	F	M	F	M	R	M	R		M	M		M	M	V	M	
	C					M		R		R							P			P	F		M							F			M	R	M		M	P		M	M	M	F	M		C	M	R	M	M		M	M	A	F	Prediscosphaera spinosa Subzone
	M					M		P		P										P			M							R			M	R	M		M	R		M		M	M	M		C	F		M	M		M	M	V	F	
R	M					M				R							R				R	P	M							R			M	F	M		M	R		M	F	M	F	M	R	C	M	R	M	M		F	M	V	F	
R	M					M		R															M							R			M	P	M		M	P		M	F	M	M	M		C	M	R	M	M		M	R	A	M	
	M					M		R													F		M							R			M	M	M		M			M	M	M	M	M	F	M	M		M	M		M	R	V	F	
	M					M		F		R										P			M							R			M	F	M		M			F	F	M	M	M	R	C	M	R	M	M		M	M	A	F	
R	C					M		R		R											R		M							R			M	R	M		M			M	F	M	M	M	M	C	M	R	M	M		M	M	D	M	
	M					M											P	P			R		M							F			M	R	M		M			F	F	M	M	M	M	C	M		M	M		M	F	A	F	
	M					M															R		M							F			M	P	M		M			M	M	M	M	M	F	C	M	R	M	M		M	M	A	M	
R	M					M		P		R										P	R		M							F			M	P	M		M			M	R	M	M	M	F	C	M	R	M	M		M	M	A	F	
	M					M		P		R											F		M							F			M	P	M		M	R		M	R	M	M	M	F	M	F	P	M	M		M	M	V	R	
P	M					M		R		P											R		M							R			M	P	M		M			M	M	M	F	M	F	M	M	R	M	M		M	M	A	F	
P	M					M		R		R										P	P		M										M	P	M		M			M	F	M	M	M	F	C	M		M	M		M	M	A	M	
P	M					M		P											P				M							P			M	R	M		M			M	F	M	M	M	R	M	F	R	M	M		M	M	A	F	Eiffellithus turriseiffeli Zone
	M					F															P		M										M	P	R		M			F	F	M	F	M	F	C	R		M	M		M	M	V	F	
	M					M		P											P		R		M							F			M	R	F		M	P		F	M	M	F	M	R	M	M		M	M		M	M	A	F	
	M					M		P												P			M							P		P	M	R	R		M	P		M	M	M	F	M	F	C	F		M	M		F	F	A	R	
	M					M															F		M							R		R	M	F	R		M			M	F	M	M	M	F	M	F		F	M		M	F	A	R	
	M					M		R													P		M							R		R	M	R	R		M			F	M	M	M	M	M	C	M	P	F	M		M	M	V	R	
	M					F														P	R		M							R			M				M			F	F	M	F	M	F	M	F		M	M		M	M	A	F	
	M					M		P													P		M							R		M	M	R			M			F	F	M	M	M	R	C	F	R	M	M		F	F	V	R	
	M					M		P												R	R		M							P		R	M	R	F		M			F	M	M	F	M	F	C	F		M	M		F		V	R	
	M					M														P	R		M							P			M	R	R		M	P		F	M	M	M	M	F	A	M	R	M	M		F	F	A	R	
	M					R															P		M							P		R	M		R		M	P		F	F	M	F	M	R	M		R	M	F		M	R	V	P	
	M					M		P											P		R	R	M							R		R	F	R	R		M			F	F	M	M	M	F	C	F		M	M		M	P	A	R	
	M					F													R		F	P	M									P	M	R	R		M			F	F	M	F	M	P	C	M		M	F		M	M	V	P	
	M					M															R		M							P			M	P			M	P		R	F	M	M	M	P	C	R		M	M		F	F	V	F	
	M					M															R	R	M									R	M	R			M			F	F	M	F	M	R	C	R		F	M		F	R	V	F	
	M					M																	M							P		F	M	R	R		M			F	F	M	F	M	F	M	F		M	M		F	R	V		
	M					F		P															M									R	M		P		F			F		M	F	M	R	M			F	F		M	R	V		
	M					F		R															M									R	M				M			F	F	M	F	M	M	M		R	M	M		M	R	V	R	Hayesites albiensis Subzone
	M					M		R											P	R	R	F	M									M	M	R	R		M	P		F	R	M	F	M	R	V	R	R	M	M		M	P	V		
	M					M		R															M							R			M	P	F		M			F	M	M	F	M	F	M	R	R	M	M			R	A	R	
	M					R		R									R		R				M							R		R	M		R		M			F	R	M	F	M	M	M	R	P	M	F		M	R	V	P	
	M					R														P	P		M										M		F		M			R	M	M	F	M	F	M	P	P	F	M		F	P	V		
	M					R																	M										M		F		M			R	R	M	F	M	F	M	P		F	M		F	P	V		
	M					M		P												P	F		M							R			M		R		M			M	M	M	F	M	F	M	P	R	F	M		F	P	V	P	
	M					R																	F									P			R		F			R	F	F	R	F	R	M	R	P	M	F		M		C	P	
	M					F															P	P	M							P		P	M		R		M			F	R	M	F	M	M	C	R		F	M		M	F	V	R	
	M					F															F		M									P	M		R		M			F	M	M	R	M	M	C	R	R	M	M		M		A	R	
	M					M															R		M									F	M		P		M			F	R	M	F	M	M	C	R	R	F	M		M	R	V		
	M					M		P													R		M										M		R		M			F	F	M	R	M	M	C	R		M	M		M	R	V		
	M					F														P	F		M							P			M				F			F	F	M	R	M	M	V	R	R	M	M		M		V		
	M					M															R		M									P	F				M			F	F	M	R	M	M	V	F	P	M	M		M		V		
	M					F		P													R		M									P	M		R		M			F	F	M	F	M	M	C	F	P	M	F		M	F	V		
	M					R															R	R	M							P		R	M		R		M			F	F	M	R	M	M	V	R		M	M		M		V	P	
	M					M		P												P	R		M										M		R		M			F	F	M	R	M	M	C	R	R	M	M		F	F	V		
	M							R													F															F	M			R		F		M		V	M	R						C		Calcicalathina oblongata Zone
	M					P		F								F					M															R	M							M		A	M	R						M		
																																													M	P									indeterminate

the remainder of the Cretaceous interval typically have high species diversity and good preservation.

The upper Aptian–lower Albian to middle–upper Cenomanian and the middle to upper Maestrichtian intervals provide complete records of recognized nannofossil biostratigraphic events. These two intervals, however, are separated by mid-Campanian–lower Maestrichtian sediments.

The Cretaceous erosional event history of the Mazagan Escarpment is not well reflected in the nannofossil biostratigraphy of Site 545. Unconformities between the Miocene and the middle–upper Cenomanian, and the upper Aptian–lower Albian and the Middle–Late Jurassic indicate major erosional events along the base of the escarpment. At Site 547, however, hiatuses separate the middle–upper Cenomanian from the lower–middle Campanian and the upper Campanian–lower Maestrichtian from the mid-Maestrichtian. These Cretaceous unconformities found at Sites 545 and 547 do not correspond in age to those found in the Moroccan Basin on Leg 50; thus bracketing the age of the unconformities within the Moroccan Basin is not possible.

A disconformity is found at Site 545 between the dolomitized limestone and overlying dolomitized nannofossil chalk. The nannofossil chalk indicates a more oceanic, deeper water environment than that represented by the platform limestone. Thus the youngest possible age for the drowning event of this portion of the platform is late Aptian–early Albian. The history of the drowning event at Site 547 is not well evidenced by nannofossil

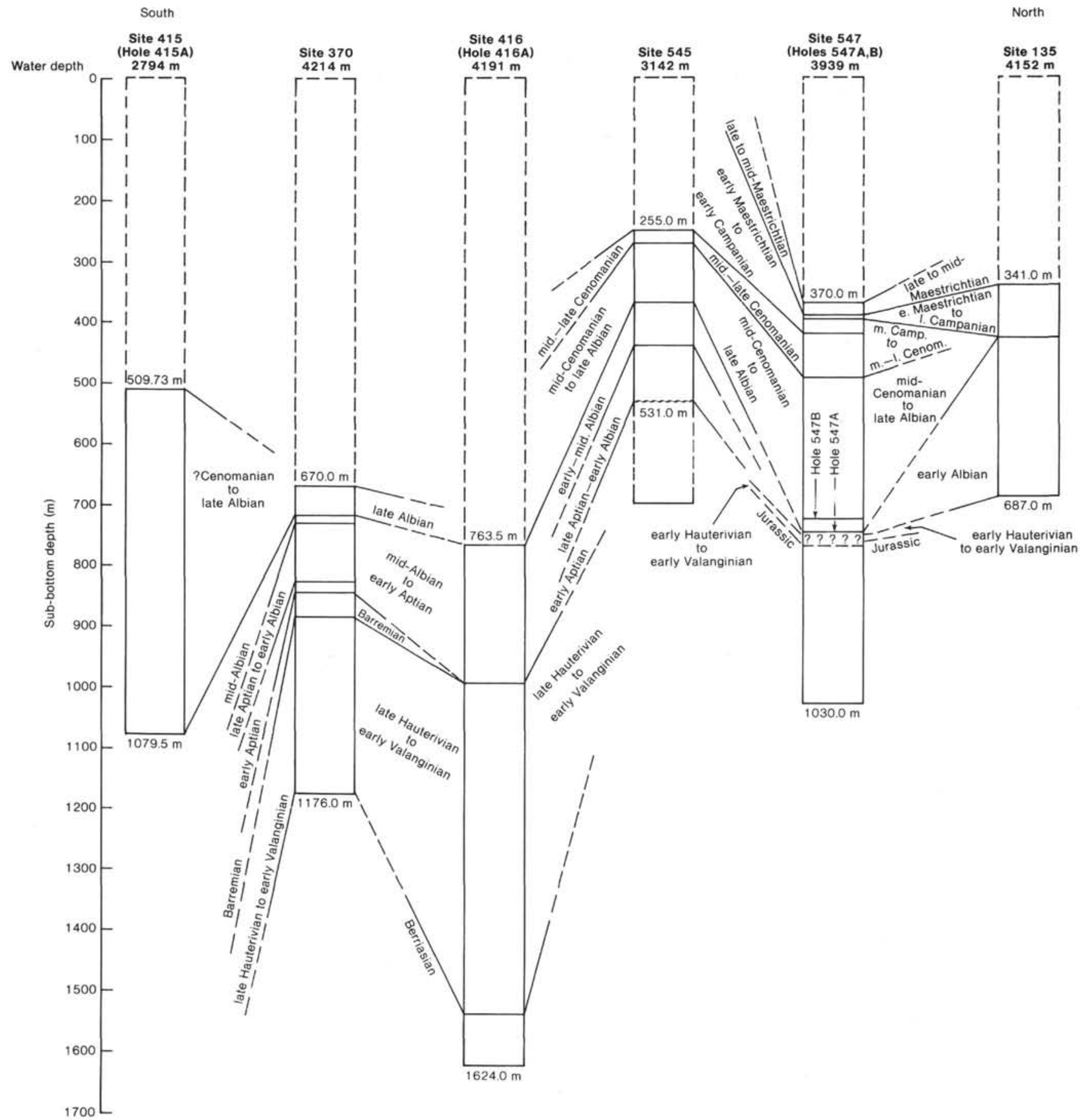

Figure 3. Comparison of Cretaceous stages using nannofossil assemblages from sites of DSDP Legs 14, 41, 50, and 79.

biostratigraphy. The hiatus between the lower Valanginian–lower Hauterivian and upper Albian in Section 547B-6-1 obscures the record, since a large amount of time is absent. The upper Albian nannofossil claystones overlying the unconformity apparently represent the youngest age of deep water sedimentation. The interbedded sequence beneath the unconformity is interpreted as having been deposited at moderate water depths (see Site 547 site chapter, this volume). It appears that between the early Valanginian–early Hauterivian and the late Albian, the platform subsided to depths where pelagic sedimentation could occur.

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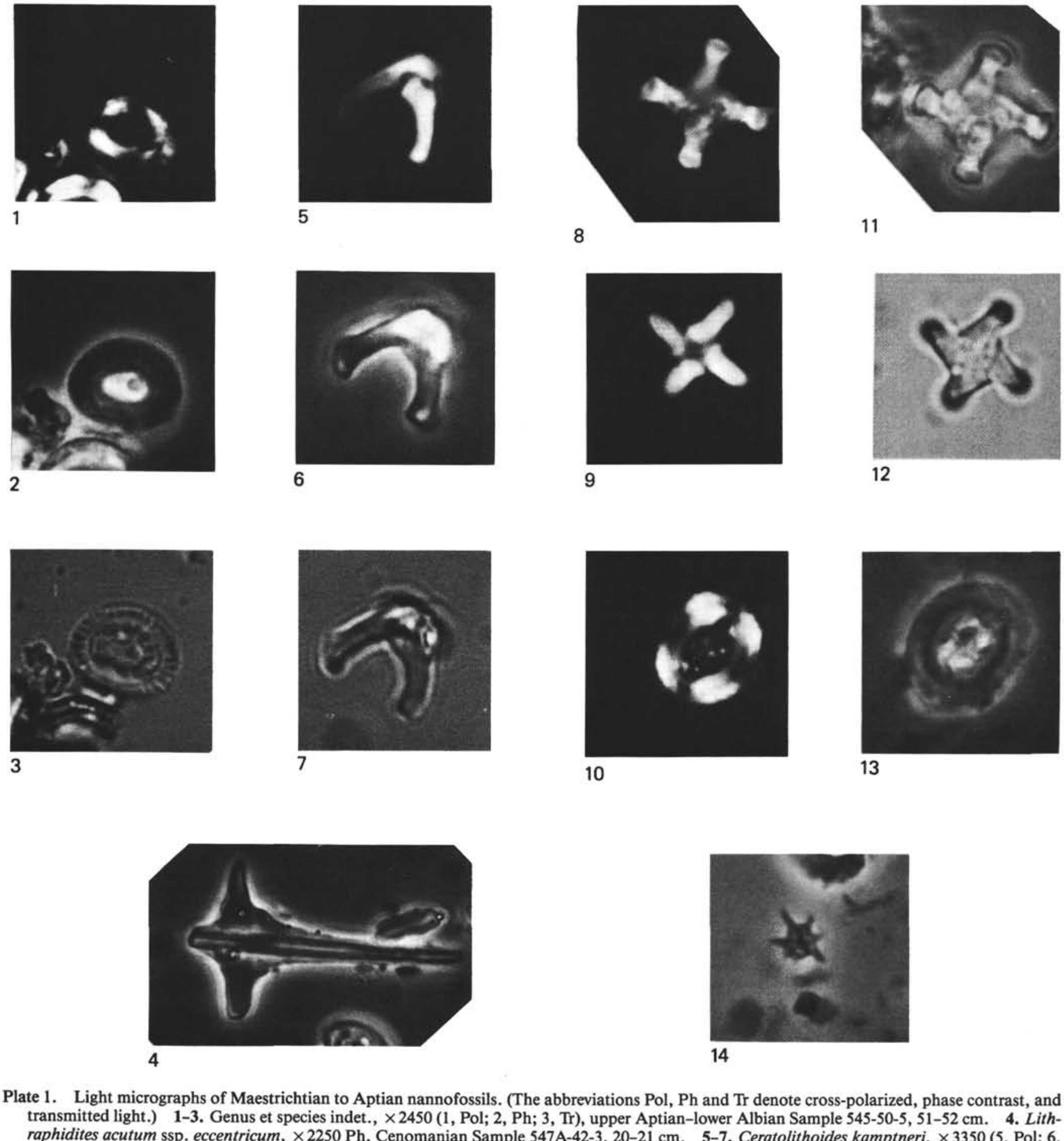

Plate 1. Light micrographs of Maestrichtian to Aptian nannofossils. (The abbreviations Pol, Ph and Tr denote cross-polarized, phase contrast, and transmitted light.) **1–3.** Genus et species indet., ×2450 (1, Pol; 2, Ph; 3, Tr), upper Aptian–lower Albian Sample 545-50-5, 51–52 cm. **4.** *Lithraphidites acutum* ssp. *eccentricum*, ×2250 Ph, Cenomanian Sample 547A-42-3, 20–21 cm. **5–7.** *Ceratolithoides kamptneri*, ×3350 (5, Pol; 6, Ph; 7, Tr), upper Maestrichtian Sample 547A-32-4, 70–73 cm. **8, 11.** *Micula prinsii*, ×3250 (8, Pol; 11, Ph), upper Maestrichtian Sample 547A-32-4, 70–73 cm. **9, 12.** *Micula mura*, ×3300 (9, Pol; 12, Tr), upper Maestrichtian Sample 547A-32-4, 70–73 cm. **10, 13.** *Cruciellipsis chiastia*, ×2350 (10, Pol; 13, Ph), upper Aptian–lower Albian Sample 545-50-5, 51–52 cm. **14.** *Haysites albiensis*, ×3200 Ph, upper Albian Sample 547B-2-5, 77–78 cm.